THE

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ELECTRICAL REVIEW.

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INDUSTRIAL PSYCHOLOGY.

THE second annual meeting of the National Institute of Industrial Psychology was held on March 20th last in the rooms of the Royal Society at Burlington House. The meeting was well attended; and, since the subject is one with which, whether consciously or unconsciously, every individual is ultimately concerned, we were glad to observe that many women were present. The necessary formal business having been got rid of quickly and without difficulty, the meeting listened with close attention to the Earl of Balfour, Sir Charles Sherrington, M.D., P.R.S., Sir Lynden Macassey, K.C., Mr. Arthur Pugh, secretary of the Iron and Steel Trades Confederation, and Dr. C. S. Myers, director of the Institute. It was regretted that Sir Robert Hadfield, who had hoped to be present and to speak, was detained abroad.

The EARL OF BALFOUR expressed the opinion that the British nation had underrated the value of the work that science was able to do for society. Science, people are too apt to suppose, is a matter for the scientist, learning a thing which interests only the learned. This view is a profound mistake. The degree of apathy in the general public and among leaders of industry is indeed far less than it was even a short time ago, but it is still sufficient to cause much anxiety to those who believe in the absolute necessity for turning science to social account.

Since we have bodies as well as minds that must be considered, physiology and psychology must work together. Everything we do involves both a bodily and a mental situation. The reports issued by the Institute show how much intelligent investigation and experiment can do to bring about improvement. Generalisation has been avoided. One of the most important directions in which intelligent effort is being pushed by the Institute is the making of such experimental investigations as will demonstrate what class of work will be most congenial to and most successfully pursued by a particular candidate for employment. If, as we observed in a recent article, we can be sure that we fit round pegs into round holes, and square pegs into square holes, the mental distress and consequent inefficiency brought about by unsuitable employment will be eliminated.

We wonder if we are too optimistic, or if it is the wish that is father to the thought, when we hope and believe that here we see some possibility of escape from unintelligent collectivism to individual freedom. It is the state of mental conflict with one's physical or human environment that brings about the discontent on the part of the operative, or the tyrannical act on the part of the foreman, superintendent, manager, or employer, that is so often found to be at the bottom of big industrial struggles. Sir Lynden Macassey, whose practical knowledge of labour problems is probably unequalled by that of any man now living, rightly pointed out that technical and practical ability, even when conjoined with judgment, tact, and discretion, are not sufficient to make a man a successful foreman. There must be a special ability to understand the mental make-up of the men whose labour he has to utilise. There are foremen's schools in the United States, and that is undoubtedly a step in the right direction. To be Prime Minister, to edit a newspaper, to handle successfully a gang of men—these are things which, the average individual considers, require no training. Common sense, that most uncommon of all the virtues, is the only thing that is needed. The work of the Institute will, in time, correct that erroneous view.

Sir Charles Sherrington, after referring to the great service which is already being rendered by the application of psychology to schools, said that equally good and important service could be given in advising how the unfavourable elements in the surroundings of the worker could be avoided, and thereby what the Duke of York had called "the commodity of happiness" largely increased and made available for more of the community. The Utilitarian school of philosophy believed, as those will remember who can read John Stuart Mill without getting angry, that human actions were determined and regulated by the consideration of what would produce the greatest happiness. We are inclined to believe that the conscious pursuit of happiness by the individual is the surest way of achieving unhappiness; but it will undoubtedly contribute to the sum total of human happiness if we can remove those elements which do definitely cause unhappiness. The individual whose mind is occupied in the consideration of his or her own personal grievances, whether it is the "she says to me" and "I says to her" of the domestic servant, or the electrical designer struggling to concentrate on a problem amid a bewildering noise of clicking typewriters and droning dictation to dictaphones, must give less than the due amount of mental energy to the service that ought to be rendered.

The National Institute of Industrial Psychology, inadequately housed, with a laboratory that the Director, Dr. Myers, described as "a wretched place," with no room for a library, is doing a work of national importance. The work it is doing has the support of labour, as was stated by Mr. Pugh, and of large employers like Sir Robert Hadfield. It cannot touch the problems confronting the industrial world without effecting improvement. We have said that the work it is doing is of national importance, but it is of individual importance too, and that is perhaps a bigger consideration. If the individuals are happy and contented, taking joy in their work, it necessarily follows that the nation will advance. Those characteristics of the English race, of which Froude speaks in his history of Queen Elizabeth's reign—a disposition to be guided by past experience, together with a restless, impetuous energy which regards what has been achieved as a step towards higher conquests—will produce their best results if properly guided and directed by those who have made it their life's work to study the psychological aspect of the matter.

It is the duty of all who are directly or indirectly concerned with industrial problems, or who have the true interests of the nation and Empire at heart, to take an interest in the work of the Institute, and to support it by every means in their power. Anyone may become a member, and receive the journal, for one pound a year. Donations, from those who can afford them, will be thankfully received, and faithfully applied.

Bilking the B. B. C.

At the first statutory meeting of the British Broadcasting Company last week, the chairman, Lord Gainford, uttered a heartfelt protest against the wholesale evasion of the rights of the company which is well known to be carried on. Whilst some 80,000 licences had been issued by the Post Office by the end of February, there can be little doubt that the number of receiving sets in use runs into hundreds of thousands, the great majority being "home-made." If this be granted, it is clear that both the State and the company are being defrauded to the tune of something like £100,000 a year, whilst the company is suffering a further loss on its manufacturing side, since ordinary licence-holders are required to use B.B.C. receiving sets, and it is quite certain that the bulk of the unlicensed listeners would be unable, because unqualified, to obtain "experimental" licences.

Plain words are necessary under such circumstances, and we do not hesitate to declare that those who receive, and doubtless enjoy, the excellent programmes of musical and other entertainment broadcast at great expense by the company from its five stations, without bearing an adequate share of the cost, and *without any intention* of paying for the privilege, are guilty of a mean and contemptible breach of trust. They are in the same category as those conscienceless persons who travel by rail without paying their fares, or crawl under the canvas into a circus tent, or divert their electricity past the meter. They are committing an act of dishonesty on every occasion when they receive the programmes; they infringe not only the laws of morality, but also the law of the land, thereby rendering themselves liable to fines and imprisonment. They have not the excuse of the starving man who steals a loaf, for radio-reception is not a necessity but a luxury, and if they cannot afford the small outlay which would enable them to enjoy the service with a clear conscience, they would suffer no harm from leaving it alone.

The reservation that we have made above with regard to the *intention* of paying for service relates to the class of persons—undoubtedly a very large one—who are willing to pay their dues but desire to make their own apparatus, yet are not qualified to acquire the experimenter's licence. Something will certainly have to be done to meet their case; possibly a 10s. licence fee together with a 10s. royalty fee, the whole of the latter and half the former to be paid to the Broadcasting Company, would be found reasonable and just. Some idea of the probable trend of events may be gained from the experience of radio manufacturers in the United States; according to the *Daily Mail* New York correspondent, an enormous demand for parts of apparatus has arisen, and it is estimated—upon what basis we are not informed—that the owners of receiving sets number more than 14,000,000. If we may rely upon this precedent, it is clear that the third class will vastly outnumber the two licensed classes in this country also. Obviously the matter is of great importance, and no time should be lost by the Post Office in dealing with the situation.

Another cause of loss to the company is the extensive sale of apparatus manufactured abroad, as well as of inferior and unauthorised sets which, it is said, frequently bear the B.B.C. transfer though no royalty is paid to the company in respect of them. There can be no doubt that the high prices charged for the genuine British-made sets strongly tend to encourage such piracy.

In order that the broadcasting system may be successful and permanent it must be remunerative to the company which is charged with the duty of providing the service; unless it is permanent the innumerable traders who are retailing apparatus and materials will lose this new and lucrative business, and the many small companies that are being formed to manufacture radio goods will find that they have built upon sand. Hence it is in their own interest, to put the matter no higher, to urge their customers to conform with the regulations; and they owe it as a duty to the company on which their business ultimately depends to safeguard its rights so far as lies within their power.

The Electrical Salesmanship Conferences.

The electrical salesmanship conference on March 16th, reported in this issue, was the last of the series for this session, and it cannot be gainsaid that they have done much good. They have, in a manner which has not been attempted before, brought prominently to the notice of all sections of the industry, and placed in proper perspective, the real fundamentals of the selling side of the electricity supply business. Indeed, these lectures in particular, and the work of the Electrical Development Association in general, may be said to have created a definite and now well recognised status for the commercial side of the industry. In a large measure in the past—and certainly before the advent of the E.D.A.—the commercial aspect of the industry was a sort of poor relation of the tech-

nical and engineering side. Now it is recognised as equally important; if anything, the commercial men may be thinking that it is the more important. Of course, the only reasonable policy is for the technical and commercial sides to work in close conjunction. In the larger undertakings the commercial section will be separate and distinct from the engineering, for it is too much to expect the supply engineer to give full attention to both. On the other hand, there are the smaller undertakings in which the scope for commercial development is just as great in relation to the size of the business, but where the commercial and business-getting side must be under the direct control of the engineer and manager. Several instances come to mind of extremely able engineers and managers who have shown an equal aptitude for both sides, and whose scale of operations has permitted them to supervise both sections. For the smaller people, as well as the larger, the organisation which the Electrical Development Association has now developed is of inestimable value inasmuch as material for propaganda and schemes for business development can be had for the asking. The E.D.A. is now in its fourth year, and never has an organisation justified itself more than this. Conferences for next session will be arranged in due course, and probably they will be held monthly instead of fortnightly. Notwithstanding their frequency this session, the attendances have been wonderfully good and the discussions long and keen, but the main purpose having been achieved, *viz.*, that of placing salesmanship in the electricity supply industry in its proper relationship to the other branches, there will not be the need next year for such frequent conferences. If those held this year have demonstrated one thing more than another, it is that there is a wealth of latent salesmanship talent in the industry which only needs the stimulus of an organisation such as the electrical industry now has, to achieve excellent results.

The Therm to Stay.

The report of the Departmental Committee to the Board of Trade on the method of charging for gas on a thermal basis, which was recently issued, not only exonerated the "therm" but established it more firmly, recommending that its use should be extended to all statutory gas undertakings. The only concessions to the consumer that are suggested are that on their meter cards, invoices, &c., shall be indicated the corresponding figures in terms of cubic feet.

It is not for us to advise our friends and competitors as to the conduct of their business; but we may say that to measure their commodity in terms of one quantity and to charge for it in terms of another appears to be somewhat anomalous, and we fail to see how this roundabout system can be, in the words of the report, "the best safeguard of the consumer." As a matter of fact, it has been stated on excellent authority—that of Dr. Charles Carpenter—that the root cause of the public agitation last year was the adoption of too high a price for the therm; evidently the "safeguard" was not then in working order.

The Situation of the German Electrical Industry.

This question was referred to by Herr Karl Friedrich von Siemens at the recent annual meeting of the Siemens and Halske Company in Berlin, particularly in respect of currency conditions. He stated that the difference between the internal and external purchasing power of the mark gave the impression to the situation of the moment, but the conversion of marks by way of the United States dollar did not constitute any measure of value as to internal economic events. The instability of the currency rendered it very difficult to compete with other countries, and because of that it was no longer possible to establish properly the degree of productivity of German works. As compared with a year ago, there was an increase in the unproductive burdens placed upon the industry, and unfortunately no improvement could be foreseen, especially as the forthcoming legal restrictions would impose new obstacles.

As to the question of the rate of dividend, the chairman stated that the 80 per cent. proposed on the ordinary shares corresponded to a yield on the present Stock Exchange quotation of 0.18 per cent., as compared with 1.8 per cent. in the previous year, or a yield of 0.016 per cent. in gold marks. The insignificant yield was a great danger to the industry, as if there was no adequate return, capital would seek other markets. The orders received by the company in March showed a diminution, and this movement was continuing. German sale prices were now above those of the world market prices; the electrical industry was dependent upon the high prices of materials and of wages, although it did not desire to sell at excessively high prices. The company only felt the effects of the occupation of the Ruhr to a slight extent, and it was still possible to get raw materials, partly with assistance from abroad. Naturally the financial requirements had largely increased, but the difficulties of production would assert themselves in a much greater measure.

The Electricity Supply Crisis.

The announcement that, as the result of a conference at the Ministry of Labour, the representatives of employers and employed have agreed to resume the sittings of the National Joint Board has dissipated the uneasy forebodings that had begun to find expression in the daily Press, which only recently became aware that a crisis was impending in the electricity supply industry. The conference lasted six hours, and according to the official statement, agreement was arrived at which removed the deadlock; the case of the Halifax Corporation will be taken up by the Board, which will meet within a few weeks. Of course, there are difficult problems to solve, and we do not suggest that all is plain sailing yet; but the thing that really matters is the fact that the National Joint Board will resume its functions, and that common sense will again have a chance of obtaining a hearing. We trust that both parties will come to the next meeting in a conciliatory spirit; concessions are due from both sides, but they can be amicably arranged under the ægis of the Whitley system, and that peace in the industry which is so keenly desired by employers and employed, and is of the utmost importance to the whole community, can be assured.

German Private and Communal Co-operation.

The annual report of the Nuremberg Electricity Company (late Schuckert), which is mainly occupied with the promotion and carrying out of electricity supply schemes, refers to the special anxiety in the matter of raising the considerable funds required for the extension of works. The report states that consumers, particularly in the case of manufacturers, have frequently been induced to participate in the subscription of capital for the development of installations and especially for the erection of distributing lines. This problem has assumed great importance in connection with "overland" stations in particular, and as a consequence of the support of the peasantry communes and among these of those owning forest land, it has been possible to provide a supply to many communes which in former years were regarded as economically out of the question, while the opening up of these country districts has also brought a market for the products of the manufacturing firms. The report further states that the company is in negotiation with a number of towns with a view to the carrying out schemes of electrical production on a joint and economic basis, and that such work has already been commenced. On the other hand, the situation in regard to tramways has become worse in consequence of the increasing costliness of everything.

THE ELECTRICAL EQUIPMENT OF THE THEATRE ROYAL, MANCHESTER.

The Theatre Royal is well known to all visitors to Manchester. It has a history which would make interesting reading if it were possible to reproduce it in anything like complete form. Unfortunately, however, in a technical paper one can but state that it was originally built in the middle of the eighteenth century, that it was first opened for strolling players, and that in the early part of this century it developed into a theatre on modern lines. It has undergone many vicissitudes, but has earned a very high reputation, alike for the number of actors of front rank who have appeared on its stage and for the class of drama which has been portrayed.

Fig. 1.—Interior View of the Theatre Royal, Manchester.

The latest development in the history of this theatre is one which would undoubtedly have shocked earlier generations, but which now can be described as being in accordance with the most modern ideas, for after the completion of a considerable scheme of rebuilding, redecoration, and re-equipment, the Theatre Royal Kinema has taken the place of the old Theatre Royal.

From the point of view of the engineer, this conversion is extremely interesting in view of the fact that a complete electrical installation formed an important part of the new scheme. Further, the installation includes automatic control gear for the arc projectors of a special type which ensures the maximum of efficiency and safety; in addition, the whole electrical control system is as simple for the operator as is humanly possible.

Power is brought into the building from the Manchester Corporation mains, and is transformed from 400 volts d.c. to 100 volts d.c. by the motor-generator sets seen in fig. 3. The lower voltage is required for the operation of the projector arcs. The general distribution to the various parts of the theatre where power is required is controlled by means of the unit-type ironclad switchboard shown in fig. 2. This board is largely in accordance with standard practice, and affords an interesting example of the adaptability of the unit-type arrangement.

As already indicated, the main points of interest centre in the bioscope control room, shown in fig. 4, and the contactor panel, fig. 5, which automatically regulates the working of the projector arcs.

There are three bioscopes; close to each of these is a panel on which are mounted seven press buttons (fig. 6). Each of these controls: (1) a projector arc, (2) dimmers for the main lighting in the theatre, and (3) the curtain and bells. Thus, the whole control of the electrical system in the theatre is in the hands of the operator, who does not have to move away from a projector which he is using at any given time. This is a great advantage in comparison with older methods. There is only one portion of the gear away from the projection apparatus; this is the pressure regulator, which is always set before the arc is struck. It is important to note that one line resistance controls the arcs of all three projectors, while one bioscope is always left in reserve.

Two bioscopes are always connected to the resistance, the arc of one burning brightly for the film being shown, whilst the other is cratering slowly for the film to follow, or with raised carbons.

The function of the seven press buttons will now be explained. First, two of the buttons control the projector arc. One is labelled "raise arc" and the other "lower arc." The buttons are pressed to increase or decrease the intensity of the arc as required, but any increase in the operating arc always produces a corresponding decrease in the cratering arc, due to the fact that both arcs work from the line resistance. It is clear, therefore, that when the second bioscope is brought into use the operator has only to press the "lower arc" button of the projector in use, and simultaneously the brightness of the incoming bioscope will be raised to any desired degree.

Fig. 2.—Unit-type Ironclad Switchboard Controlling the whole of the Electrical System in the Theatre.

The arc press buttons control a line resistance through a small reversible motor, one button operating the motor in one direction and the other in the reverse; the line resistance is inserted in series with the arc or cut out of

circuit according to the direction of rotation of the motor, decreasing or increasing the brightness of the arc as required.

Secondly, two other push buttons are used for controlling the dimming of the theatre lighting. Here, again, the push buttons control a small reversible motor, this in turn controlling the dimming resistance. Once a button has been pressed, the action of the dimmer goes on continuously through the medium of automatic contactors until the lights are out.

A noteworthy feature in connection with the dimmers is the employment of contactors to short-circuit the dimming resistance by the pressure of emergency lighting buttons in various parts of the theatre; this will instantly restore the lights to their full brightness in case

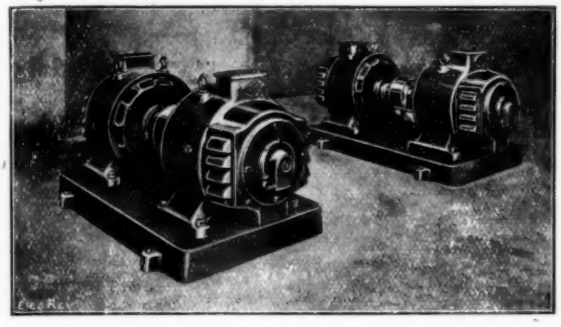

Fig. 3.—20-kW Motor-Generator Sets for Converting 400 Volts d.c. to 100 Volts d.c., Speed 1,050 r.p.m.

of emergency, irrespective of the control of the bioscope operator.

Thirdly, two of the remaining buttons are used for the control of the curtain motor, and once a button has been pressed the action of raising or lowering the curtain goes on continuously until finished; a set of press buttons at the stage front also allows of the operation of the curtain in a similar manner.

The last of the seven buttons is for use in case of alarm, to attract the attention of the engineer in the basement power room in the event of any failure in the supply.

The press buttons used for the above controls are of special design, and are fitted with shielding caps of various colours to avoid any possibility of error in operation; it is to be noted that the operator has complete control of the electrical equipment from any one of the bioscopes.

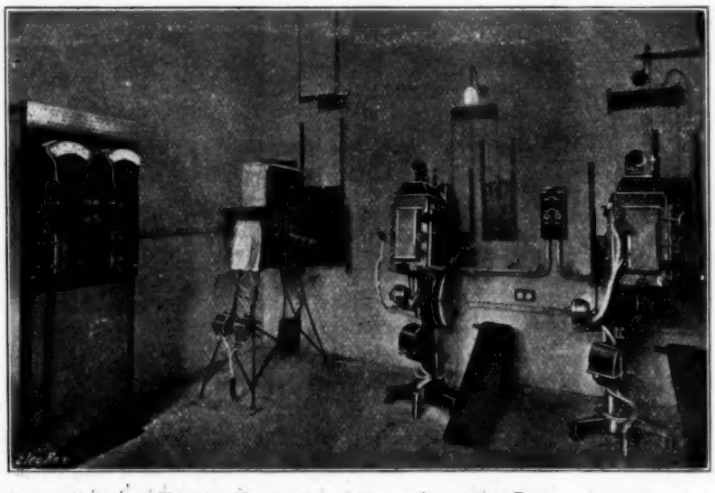

Fig. 4.—Projection Arcs in Operating Room.

It has previously been stated that three projector arcs are available, and in the operator's room a small panel is provided with special change-over switches to allow Nos. 1 and 2, Nos. 2 and 3, or Nos. 1 and 3 projectors to be used as desired. These change-over switches are arranged so as to select and operate the contactors controlling the connections of the projector arcs and line resistance in a definite and correct manner to give the required combinations; time-limit relays are

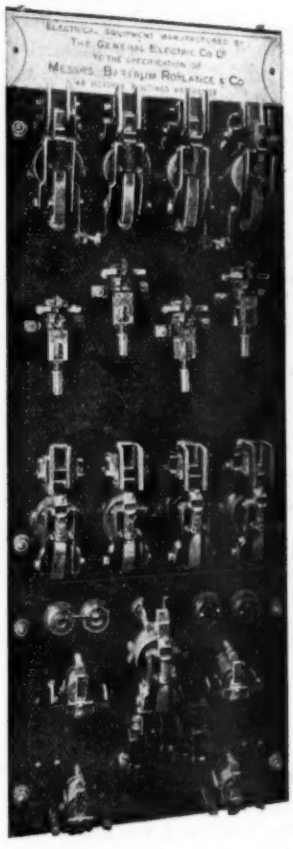

Fig. 5.—Automatic Contactor Panel for Control of Projection Arcs.

Fig. 6.—Push-button Panel.

also provided to give efficient protection against overload.

A further feature of the operator's panel is the provision of press buttons for controlling the voltage supplied to the arcs; these buttons control a small reversible motor operating the shunt regulator of the generators, and allow the voltage to be varied as desired, while two sector-shaped instruments allow of observation of both pressure and current.

It should be mentioned that suitable interlocks have been fitted wherever necessary, making the operation reliable and mistake-proof.

From the foregoing description will be realised the many advantages which are derived from the installation of electricity in kinema theatres, especially in view of the extremely simple methods of control, the whole of which is in the hands of one man. Equally it will be appreciated that in case of emergency the various push-buttons in other parts of the theatre render it possible for any of the theatre officials or attendants to take emergency steps.

The whole of this installation was designed and carried out by Messrs. Bartrum, Roylance and Co., Ltd., of Manchester, while the motor-generators, automatic control gear, switchgear, &c., were manufactured at the Witton works of the General Electric Co., Ltd.

D

THE CALCULATION OF D.C. AND A.C. NETWORKS.

By F. T. CHAPMAN, D.Sc., M.I.E.E.

The purposes of the present article are to draw attention to the "Break" or "Cutting-point" theorem, which is already fairly well known in connection with d.c. networks, to introduce a complementary theorem, and to show the usefulness of both for a.c. circuits.

(1.)

The currents in the various branches of such a d.c. network as that shown in fig. 1, can be calculated quite easily by applying Kirchhoff's laws in a straightforward manner, and the results are shown on the figure.

In applying the "Break" theorem to this problem the procedure is as follows:—(1) Open the circuit in one

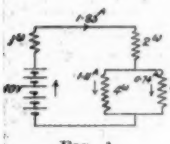

Fig. 1.

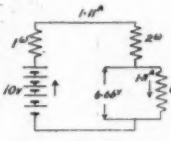

Fig. 2.

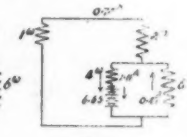

Fig. 3.

branch and under these conditions calculate the currents in the other branches and the p.d. v across the break, as in fig. 2. (2) Remove the original source of e.m.f. but close the circuit at that place, and bridge the artificial break by a resistanceless source of e.m.f. giving v volts in the direction of the current which would normally flow in the broken conductor; *i.e.*, the direction of the e.m.f. is that in which the potential falls across the break. (3) Calculate the currents in the various conductors under these circumstances, as in fig. 3. (4) Superpose for each branch the currents obtained in (1) and (3) and thus obtain the true currents as calculated in the ordinary way. The superposition of the currents in figs. 2 and 3 gives the same distribution as is shown in fig. 1,

It is quite obvious that in such a case as this the theorem presents no advantages over the more usual method of procedure. It may be applied with advantage, however, to a mesh such as that shown in fig. 4, which represents the positive side of a ring distributor fed at A and tapped at B, C and D. The supply current I_{41}, and the load currents I_{12}, I_{23}, and I_{34}, are supposed known, while the currents in the mesh, I_1, I_2, I_3 and I_4, are to be found. The arrow-heads in fig. 4 denote the directions which are regarded as positive.

We shall suppose that the supply and load currents are unaffected by such changes as are imagined for the purpose of applying the "Break" theorem. Suppose branch DA is opened, then I_4 will become equal to I_{34}, I_3 to $(I_{34} + I_{23})$, and I_1 to $(I_{34} + I_{23} + I_{12})$. The p.d. across the break is—

$$I_{34} R_3 + (I_{34} + I_{23}) R_2 + (I_{34} + I_{23} + I_{12}) R_1 = V \text{ (say)} \quad (1)$$

the fall of potential being from A to D.

Now remove the original sources of e.m.f., thus removing also the currents I_{41}, I_{23}, &c., and apply an e.m.f. v to the closed mesh in a counter clockwise sense, *i.e.*, from A to D along AD. The current produced is

$$V/(R_1 + R_2 + R_3 + R_4) = I \quad \ldots \quad (2)$$

Superposing this current upon the currents obtained when the branch AD was open we see that it gives us $I_4 = -I$, $I_1 = I_{41} - I$, $I_2 = I_{23} + I_{34} - I$, and $I_3 = I_{34} - I$.

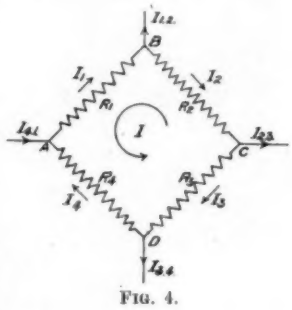

Fig. 4.

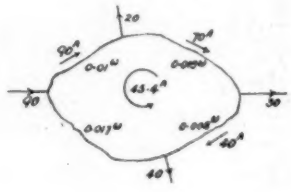

Fig. 5.

In such a case as this the theorem enables us to solve the problem with a small number of equations.

A numerical example will serve to show that this is so. The data are given in fig. 5, and we derive

$$V = 90 \times 0{\cdot}01 + 70 \times 0{\cdot}015 + 40 \times 0{\cdot}008 = 2{\cdot}27$$
$$I = 2{\cdot}27 \div (0{\cdot}01 + 0{\cdot}015 + 0{\cdot}008 + 0{\cdot}017) = 45{\cdot}4$$
$$I_1 = 90 - 45{\cdot}4 = 44{\cdot}6, \qquad I_2 = 70 - 45{\cdot}4 = 24{\cdot}6$$
$$I_3 = 40 - 45{\cdot}4 = -5{\cdot}4, \qquad I_4 = -45{\cdot}4.$$

In more complex cases the gain may be greater.

(2.)

Let us now see how a similar theorem can be applied to an a.c. network. Fig. 6 shows a simple network which might be a mesh-connected load on a three-phase system,

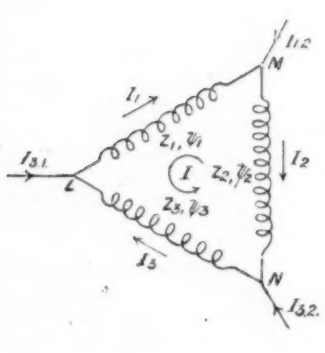

Fig. 6.

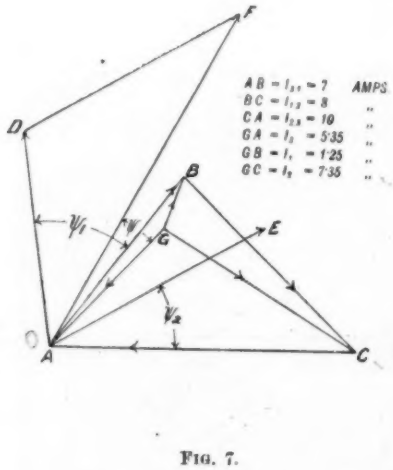

Fig. 7.

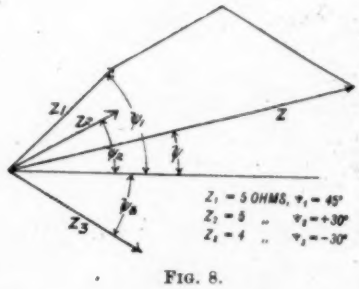

Fig. 8.

or the mesh-connected windings of an alternator or a bank of transformers, or it might be one side of a single-phase ring-distributor. It is a network which has been discussed in the pages of the Electrical Review on several recent occasions. In the case of the alternator or transformer the induced e.m.f.'s balance round the mesh or else they produce a circulating current which is independent of the load currents. These balanced e.m.f.'s and the circulating current, if any, do not enter into our calculations.

Referring to fig. 6, the impedances of the arms of the

mesh LMN are z_1, z_2, and z_3 respectively, and ψ_1, ψ_2, and ψ_3 are the respective angles by which the current lags behind the e.m.f. in each case. The currents I_{31}, I_{12}, and I_{23} are known as well as the z's and the ψ's, and the problem is to determine I_1, I_2, and I_3.

The arrow heads on the figure denote the directions regarded as positive.

Whereas in the d.c. case the algebraic sum of the currents approaching the mesh is zero, in the a.c. case of fig. 6 the vector sum of I_{31}, I_{12}, and I_{23} is zero, *i.e.*, the three vectors form a triangle, as ABC in fig. 7, when taken properly in order.

Let us suppose the third branch of the mesh (NL) to be cut, then the current in branch LM will be I_{31}, and in branch MN it will be $(-I_{23})$. These two currents are shown by AB and AC respectively in fig. 7. Fig. 8 shows the three impedances, z_1, z_2 and z_3, with their characteristic angles, and also z, the total impedance of all three branches in series, with its characteristic angle ψ found by vector combination. With branch NL open the fall in potential from L to M is given by a vector the length of which is proportional to $I_{31} \times z_1$, and which leads the vector AB by the angle ψ_1. Similarly the fall from M to N is given by a vector representing $(-I_{23}) \times z_2$, and leading the vector AC, which represents $(-I_{23})$ by the angle ψ_2. These vectors are shown by OD and OE in fig. 7. The total fall of potential from A to C is given by OF.

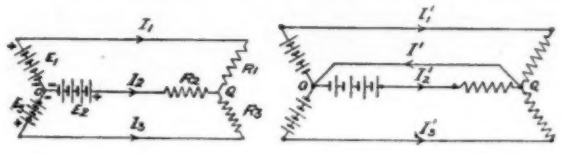

FIG. 9.

FIG. 10.

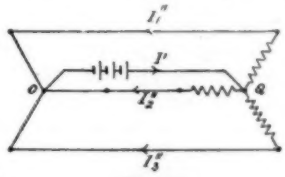

FIG. 11.

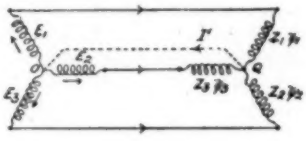

FIG. 12.

Now following the same procedure as in the d.c. case, we imagine the branch NL closed, and an e.m.f. equal to OF, and in phase with it, applied in a counter clockwise direction round the mesh. The circulating current produced (I) is equal to $V \div z$, and its vector lags behind the vector OF by the angle ψ; it is represented by AG in fig. 7. Then $-\mathbf{I} = -\overline{AG} = \overline{GA}$ is the current which will flow in the branch NL under the real conditions of the original problem, *i.e.*, $\overline{GA} = \mathbf{I}_3$; moreover, if we join G to B and C, we obtain vectors representing $\mathbf{I}_1$ and $\mathbf{I}_2$, respectively, for $\overline{GB} = \overline{GA} + \overline{AB} = \mathbf{I}_3 + \mathbf{I}_{31} = \mathbf{I}_1$, and $\overline{GC} = \overline{GA} = \overline{CA} = \mathbf{I}_3 - \mathbf{I}_{23} = \mathbf{I}_2$. The data which have been employed in constructing figs. 7 and 8 are indicated thereon.

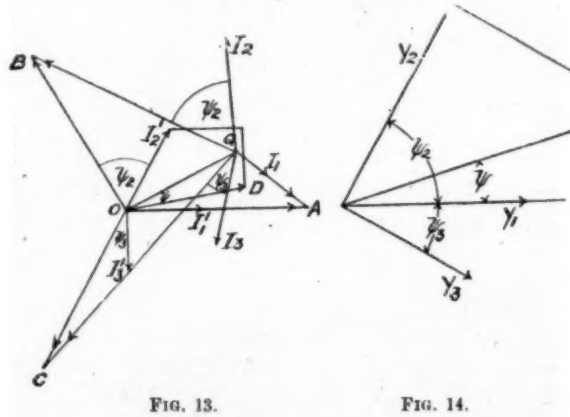

FIG. 13.

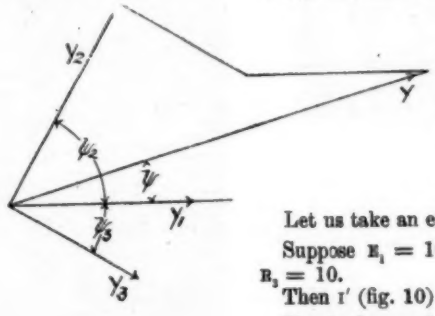

FIG. 14.

(3)

The d.c. network shown in fig. 9 admits of easy solution by ordinary methods. We assume V as the drop of potential from Q to O, and derive the following four equations from which the four unknowns V, I_1, I_2, and I_3 can be determined.

$E_1 - I_1 R_1 = V = 0$ ... (3) $\quad E_2 - I_2 R_2 - V = 0$ ... (5)

$E_3 - I_3 R_3 - V = 0$ ... (4) $\quad I_1 + I_2 + I_3 = 0$ ... (6).

But the problem may also be solved in the following manner. Imagine OQ joined by a resistanceless conductor, as in fig. 10, then the currents which would flow would be—

$I_1' = E_1/R_1$, $I_2' = E_2/R_2$, $I_3' = E_3/R_3$, and $I' = I_1' + I_2' + I_3'$.

We next imagine the original e.m.f.'s removed, as in fig. 11, and an e.m.f. inserted in OQ sufficient to produce a current equal and opposite to the I' of fig. 10. If this e.m.f. be V, then—

$$V/R_1 + V/R_2 + V/R_3 = I' = E_1/R_1 + E_2/R_2 + E_3/R_3,$$

whence—

$$V = (E_1/R_1 + E_2/R_2 + E_3/R_3)/(1/R_1 + 1/R_2 + 1/R_3) \ldots (7)$$

(It will be seen that this V is the same as that of equations 3 to 6 which were deduced from fig. 9.) Under these conditions, the currents in the three branches are $I_1'' = V/R_1$, $I_2'' = V/R_2$, and $I_3'' = V/R_3$, respectively. The real currents under the original conditions of the problem are, from equations 3 to 6—

$$I_1 = E_1/R_1 - V/R_1 = I_1' - I_1'' \ldots \quad \ldots (8)$$

$$I_2 = E_2/R_2 - V/R_2 = I_2' - I_2'' \ldots \quad \ldots (9)$$

and $\quad I_3 = E_3/R_3 - V/R_3 = I_3' - I_3'' \ldots \quad \ldots (10)$

Here we have an application of another theorem complementary to the "break" theorem, which can be stated thus: "In any network, if we connect together any two points O and Q by a resistanceless conductor, a current I' will flow along it if there is originally a difference of potential between O and Q. Let V be the e.m.f., which, inserted in OQ, would produce a current along it equal and opposite to I' when the other e.m.f.'s were removed. Then the currents and p.d.'s in the various branches of the circuit under the real conditions (represented in fig. 9) will be obtained by superposing those calculated in the two imaginary states (represented by figs. 10 and 11 respectively), *i.e.*, the current in OQ is zero, the potential of Q is higher than that of O by V, and the currents in the other branches are $I_1 = I_1' - I_1''$, $I_2'' = I_2' - I_2''$, &c."

The equations 7 to 10 can be obtained from 3 to 6 by mathematical transposition so that this theorem, like the "break" theorem, merely employs a physical transformation instead of a mathematical one.

Let us take an example by way of illustration—

Suppose $E_1 = 10$, $R_1 = 3$, $E_2 = 15$, $R_2 = 5$, $E_3 = 20$, $R_3 = 10$.

Then I' (fig. 10) $= 10/3 + 15/5 + 20/10 = 8{\cdot}33$ amps.

If V is the e.m.f. which must be inserted in fig. 11 then

$$V/3 + V/5 + V/10 = 8{\cdot}33,$$

therefore $V\ (0{\cdot}333 + 0{\cdot}2 + 0{\cdot}1) = 8{\cdot}33$ amps.

$$V = 8{\cdot}33/0{\cdot}633 = 13{\cdot}15 \text{ volts},$$

and $I_1 = I_1' - I_1''$

$= 10/3 - 13{\cdot}15/3$

$= -1{\cdot}05$ amps.

$I_2 = I_2' - I_2'' = 15/5 - 13{\cdot}15/5 = 0{\cdot}37$ amp.

$I_3 = I_3' - I_3'' = 20/10 - 13{\cdot}15/10 = 0{\cdot}68$ amp.

It is not suggested that this "inserted conductor" theorem is likely to find much application in d.c. calculations, because it is an easy matter to make up equations containing the unknown V and to solve them. In the graphical solution of a.c. problems, however, we cannot readily insert an unknown vector and solve for it and the procedure outlined above can be used with advantage.

(4.)

Let us suppose that we have a star-connected generator giving e.m.f.'s E_1, E_2 and E_3, and supplying power to a star-connected load as in fig. 12, the star points, O and Q

respectively, being independent of one another. Let the impedances of the three branches of the load be z_1, z_2 and z_3 with characteristic angles ψ_1, ψ_2 and ψ_3 respectively. The e.m.f. vectors are shown by OA, OB and OC respectively in fig. 13, which has been drawn to represent a case where $E_1 = E_2 = E_3 = 100$ volts, the phase differences being 120° in each case, $z_1 = 10$ ohms, $z_2 = 8$ ohms, $z_3 = 12{\cdot}5$ ohms, $\psi_1 = 0$, $\psi_2 = 60°$, and $\psi_3 = -30°$.

It is convenient in this problem to work with admittances instead of impedances, so in fig. 14 vectors have been drawn to represent $Y_1 = 1/z_1$, $Y_2 = 1/z_2$, and $Y_3 = 1/z_3$ respectively, the characteristic angles remaining as before.

Now proceeding according to our theorem we imagine O and Q joined by an impedanceless conductor and find the current in OQ as the vector sum of $I_1' = E_1Y_1$, $I_2' = E_2Y_2$, and $I_3' = E_3Y_3$. This current I′ is shown as OD in fig. 13.

We next find the e.m.f. which must be inserted in OQ to drive along it a current equal to I′, the conditions being similar to those shown for the d.c. circuit in fig. 11. The three branches of the load are in parallel in the path of this current, and their total admittance is the sum of their separate admittances; it is shown as (Y, Ψ) in fig. 14. The e.m.f. required will be represented, therefore, in fig. 13 by a vector OQ of length I′/Y, to the volt scale, which is drawn in advance of I′ by the angle Ψ. This vector represents the p.d. between O and Q when there is no fourth wire, a rise of potential from O to Q being regarded as positive. The actual p.d.'s in the various branches are given by the vectors $\overline{QA} = $ vector difference between $\overline{OA}$ and $\overline{OQ}$, $\overline{QB} = \overline{OB} - \overline{OQ}$, and $\overline{QC} = \overline{OC} - \overline{OQ}$, the lengths of which are, say, E_1', E_2', and E_3'. The currents in the three branches can now be found as $E_1'Y_1$, $E_2'Y_2$, and $E_3'Y_3$, and their vectors can be drawn; they are shown as I_1, I_2, and I_3 in fig. 13. A useful check on the calculations is furnished by the fact that these three current vectors should form a triangle when taken properly in order.

No formal proofs of these theorems have been given, as they are quite simple, and the interested student will take pleasure in deriving them for himself; he will also observe that the problems in sections (1) and (2) could be done by the "inserted conductor" method, while those in sections (3) and (4) could be solved by the "break" method.

It may be useful to emphasise further an interesting property of a three-phase star-connected system such as that of fig. 12, *viz.*, that if V is the p.d. between the two neutral points when they are not connected, I is the current which flows between them when they are connected, and Z is the total impedance of all three circuits when connected in simple parallel, then $V = IZ$.

NEW SHOWROOMS AT LEICESTER.

In fitting sequence to the recent opening of its new power station, the Leicester Corporation, through its responsible administrative committee, has taken steps to bring

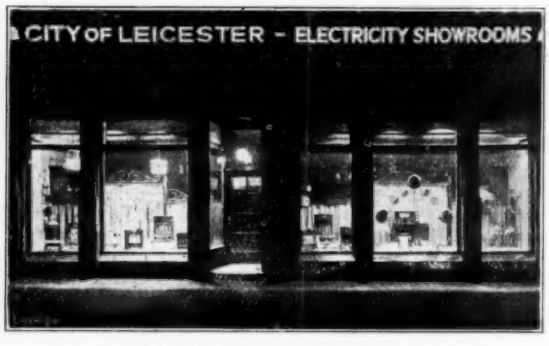

Fig. 1.—Exterior, at Night.

prominently under public notice the advantages appertaining to the use of electricity for cooking and heating purposes. The inauguration last week of excellently

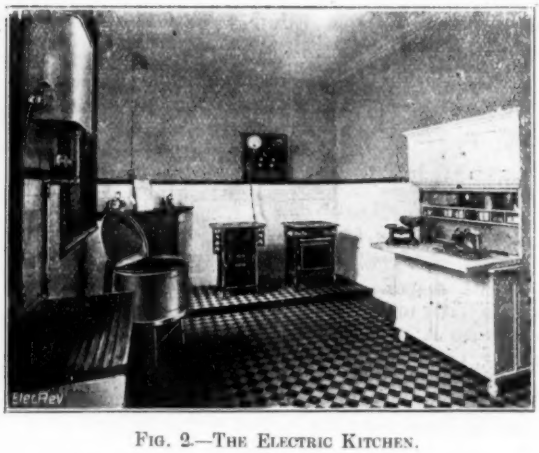

Fig. 2.—The Electric Kitchen.

arranged showrooms in Market Street marks a new departure, affording interesting means for arriving at a decision as to the relative technical merits of various appliances and the cost involved in their employment. Great discrimination has been manifested in bringing together apparatus which is designed to illustrate in the most practical form the efficiency and comparative inexpensiveness of the use of electricity for culinary purposes. In connection with the formal opening of the showrooms, luncheon was admirably cooked by means of the appliances on view, and served to the invited guests who assembled under the presidency of Alderman Flint, chairman of the Electricity Committee. Emphasis was laid upon the economy afforded by a cleanly and

Fig. 3.—One of the Showrooms.

expeditious cooking process, it being found in respect of two joints prepared for the luncheon, these weighing together 15 lb. 2¾ oz. that a loss of 12¼ oz. only was involved. Dealt with upon the same stoves were soup and two vegetables, as well as four apple tarts, it being explained for the information of the visitors that the cost involved in the consumption of electricity for cooking the whole was only 8¼d. The estimate therefore suggested by Ald. Flint that the cooking for a family of four could be well effected at a cost not exceeding 2s. 6d. per week did not err upon the side of exaggeration. The Committee has adopted a generous policy to foster

the use of the new appliances, which are to be lent on eminently reasonable terms. For ten shillings a quarter a small "Tricity" cooker may be hired, sufficient to cook for four to six persons, this charge including the loan of a three-pint kettle; a larger appliance to cook for a family up to 12 persons was available for hire for 12s. 6d. per quarter, the charges including repairs and maintenance. Special wires must necessarily, however, be laid for cooking and heating purposes, and the cost of these, as stated by Mr. T. R. Smith, city electrical engineer, in reply to questions at the opening proceedings, must necessarily depend upon the length to be laid, the average being placed at round about £2 10s. per house. In the course of the speeches, Ald. Flint, mentioning that the Electricity Department made a profit of £53,000 last year, explained that £10,000 of this was to be expended on extending the cables into districts not now supplied with electricity. Thus the laudable aim is to make the current both for lighting and cooking purposes generally available. It is significant evidence of municipal enterprise in this direction that in Leicester the Electricity Committee is installing electric cookers in all the new houses built under municipal control.

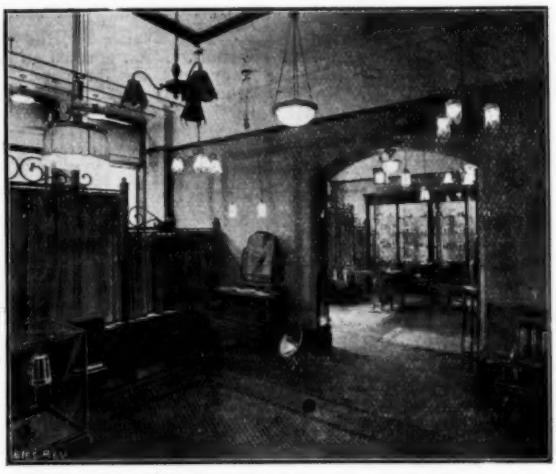

Fig. 4.—An Interior View.

A new tariff embodying a reduction of rates has been adopted in conjunction with the opening of the showrooms, and particular attention is directed to the domestic tariff, which consists of a fixed annual charge plus one penny per kWh for all electricity consumed in the house. An alternative flat rate system is available, under which lighting is charged for at 6d. and heating or cooking at 1½d. per kWh. The Electricity Department is laying itself out to give the citizens every facility for acquiring accurate information regarding the uses of electricity and for applying it to the best advantage; a new system of dealing with consumers' business is being put into operation, and the advice of an expert staff is placed at their disposal free of charge.

We are enabled by the courtesy of Mr. T. R. Smith to give herewith some views of the exterior and interior of the new showrooms.

APPRENTICES IN THE ENGINEERING TRADES.

The Need for a Policy.

By FREDERICK W. POPE.

The future of the engineering trades is in the hands of the boys who are now entering engineering workshops. The same might be written of any other industry, but, in the case of engineering, it has a special significance. The British engineering tradition is still respected throughout the world; how will it endure the changed conditions of to-morrow?

The slump has caused a reaction upon the popularity that engineering, as a trade full of possibilities, enjoyed a year or two ago. It has painted the future in somewhat dark shades. Parents have been urged not to send their boys into engineering shops; pessimists declare that so far as this country is concerned the trade is "finished."

If this were true, the outlook would be gloomy indeed, for the state of business for engineering products is often an index to the state of business generally. The obvious conclusion to be drawn is that no section of industry will be secure.

The truth is, of course, that not only are we suffering for the false prosperity which obtained during the war, but also that great changes are taking place in methods of production. Automatic and semi-automatic machines are coming into more general use, and this tendency will grow.

On what ground, then, can it be recommended that boys with the necessary inclinations should be apprenticed to the trade? On the ground that there will always be a demand for highly-skilled men.

It is here that the employer has a certain responsibility. How are the "necessary inclinations" to be discerned?

We know that in addition to a keenness for *practical* engineering there should also be a liking for mathematics and machine drawing; that the boy need not be brilliant on these two subjects, but will not get far without them; yet we are inclined to smile when we see a questionnaire such as some up-to-date firms use.

What are your hobbies? How do you spend your evenings? Such questions as these, in the hands of a man of sympathy and imagination, put the boy at ease, and give him confidence to talk of things which appeal to him most. Thus unconsciously he gives just the information required, and from this the management is enabled to form a broad idea of his natural inclinations.

To what extent is it possible to devise a system of training which could be applied to any workshop in the industry?

The apprentice of to-morrow may have to specialise to some extent. Against this, however (granted that some system of training is generally adopted), he will possess the invaluable asset of knowing the "one best way" in workshop practice. Further, he must be encouraged, and even helped, to attend technical classes. It would be all to the good if the practice of many firms in affording their boys some technical training during working hours could be more widely applied.

Has the engineering trade any future in this country? The question seems absurd except to those who say it has not. We must believe that it has a future which cannot be anything but good. When the world returns to normal conditions we shall get as much of its work as we can do. Re-organisation will be necessary in many of our factories, and it is here that the skilled man will get his opportunity. He will set up for unskilled workers; he will supervise, experiment, make gauges and tools; he will supervise, experiment, make gauges and tools; which an outsider would describe as impossible.

If the British engineering tradition is to survive the new industrial revolution, it is for British engineers to show how it must be done. And it should not be forgotten that the biggest factor in the problem is the boy who, to-day, goes before the foreman for his first job.

LEGAL.

Bootle Corporation v. Openshaw & Openshaw.

At Bootle Police Court, on March 19th, Charles Milton Openshaw and Percy Openshaw, trading as Openshaw Bros., electricians and public amusement caterers, Bootle, and Frank William Openshaw, electrician, another brother, were summoned for fraudulently consuming electricity belonging to the Corporation. The Deputy Town Clerk (Mr. Joseph Wilson) said the two brothers in partnership occupied the two lower rooms of a building in Garden Lane as offices. Prior to November, 1922, when the three defendants became the tenants, the electricity supply to the building had been cut off, and the two meters removed. There had been no application from either of the defendants for a resumed supply, but on January 19th, at 4.30 p.m., a meter examiner of the Bootle Corporation saw an electric lamp burning in Frank Openshaw's room, and a workman was found moulding plaster with the aid of the lamp. The building had been rewired throughout, and connection effected by piercing the cable and attaching wires. It was thought that the current had been used irregularly for at least a month. One defendant said he had been away from Bootle on business for some weeks, and he knew nothing about the matter. The others declared that a fourth brother who had no interest in the premises was given orders by Frank William, in the absence of the others, to wire the premises in view of an application for meters and light.

The Bench fined Frank Openshaw £10 plus two guineas for the advocate's fee. The summonses against Charles M. Openshaw and Percy Openshaw were dismissed. Mr. F. Openshaw said that he would consider the question of an appeal.

British Thomson-Houston Drawn-wire Patent.

Threatened Action.

Before Mr. Justice Sargant, in the Chancery Division on March 23rd, Mr. Trevor Watson, appearing for plaintiffs in the action of the British Thomson-Houston Co. against George Hunt, trading as Forum & Co., Dudley Street, Birmingham, moved for an interlocutory injunction restraining defendant from infringing plaintiffs' drawn-wire patent granted in 1909. Mr. Courtney Terrell appeared for the defendant.

Mr. Watson stated that the position in this case was that in June, 1921, it was discovered that defendant was selling tungsten wire lamps and other lamps, and three writs were issued against him. In one of the actions an injunction was granted by consent, the motion was treated as the trial of the action, and judgment was taken in 1922. In the other two actions, defendant represented himself as being an extremely poor ex-Service man, and as the result the plaintiffs agreed to accept an undertaking out of court and to withdraw the actions. Considerable correspondence passed, and in November, 1922, the defendant gave an undertaking not to infringe either plaintiffs' half-watt lamp patent or their drawn-wire patent. After that undertaking had been given it came to plaintiffs' knowledge that defendant was continuing to sell drawn-wire lamps, and plaintiffs remonstrated with him about it. Considerable correspondence passed, defendant pretending that he did not appreciate that the undertaking related to the drawn-wire patent, but that it only applied to the leading-in wire and half-watt lamp patents.

Mr. Terrell, for the defendant, said he admitted that the undertaking was given, but his first point was not an undertaking of court, and he was entitled to withdraw it, and he did withdraw it. Defendant contended that the undertaking was given under a mistake; he thought it was with respect to the two other patents. Defendant, added counsel, was going to fight the drawn-wire patent. Plaintiffs had three patents—the drawn-wire, the half-watt, and the leading-in wire. As to the last two, their position was secure. The half-watt patent had been to the House of Lords, and the leading-in wire patent had been before Mr. Justice Astbury, but the drawn-wire patent had never been fought at all, and the difficulty was to get the plaintiffs to fight it. About 100 writs had been issued, all against small users, and now the defendant was willing to fight them.

Mr. Watson said there was a similar action pending in Scotland.

Mr. Terrell: It won't be tried before June. Defendant, in this case, is being backed by the manufacturers, and we are anxious to fight the action here. I say we are *bona fide* attacking this patent which we say is invalid. Directly defendant was written to about this supposed undertaking, he replied that he had no idea he had signed an undertaking as to this patent. He thought he was dealing with the leading-in wire and the half-watt patents.

Mr. Watson: He did not tell your Lordship that the manufacturers are people who dwell in Holland and cannot be got at. We have at the present moment in this country an action pending on the same patent against another company, and as to which an application is being made for a speedy trial. If we are to be forced to fight the action against these gentlemen, will my friend's clients the manufacturers allow themselves to be added as defendants?

Mr. Terrell: I think so, but I am afraid I must have instructions about that. I don't think there will be any difficulty. We are the largest manufacturers in the world.

His Lordship said the motion would stand over until Wednesday, and in the meantime Mr. Terrell could ascertain the attitude of his prospective clients.

British Thomson-Houston Patents.

In the Chancery Division, on Friday, Mr. Justice Sargant, on a motion by the British Thomson-Houston Co., granted an *ex parte* injunction to restrain the defendants, the Premier Electrical Stores, from infringing plaintiffs' patent relating to half-watt lamps.

His Lordship: You want to prevent their parting with possession?

Mr. Trevor Watson (for plaintiffs): Yes.

His Lordship: You can take the *ex parte* injunction over Wednesday.

In the Chancery Division, on Friday, March 23rd, Mr. Justice Romer granted injunctions restraining infringements of the British Thomson-Houston Co.'s patent for leading-in wires for electric lamps by L. M. Don and the Premier Electrical Stores.

The motions were moved *ex parte*, and Mr. Trevor Watson (for plaintiff company) said " parting with possession of " were essential words of the motion.

In the Chancery Division before Mr. Justice Sargant, on Thursday, March 22nd, Mr. Trevor Watson moved for judgment in default of defence in the action of the British Thomson-Houston Co., Ltd., against Electric Auto Supplies and Another. Counsel said the action was to restrain infringement of letters patent relating to leading-in wires.

His Lordship granted the injunction as asked.

Attorney-General v. Southport Corporation.

The Court of Appeal, consisting of the Master of the Rolls and Lords Justices Warrington and Younger, on Friday, March 23rd, delivered a considered judgment in the appeal of the Attorney-General against a judgment of Mr. Justice Eve in an action at the relation of the Birkdale District Electric Supply Co. for an injunction to restrain the defendant Corporation from supplying electricity for traction in the urban district of Birkdale or for the lighting of the public lamps there. The judgment of Mr. Justice Eve, against which the Attorney-General appealed, dismissed the action. *Vide* Elec. Rev., July 14th and 28th, 1922.

Mr. Mangham, K.C., and Mr. Guest Mathews appeared in support of the appeal, and Mr. Tomlin, K.C., with Mr. Bischoff represented the respondent Corporation.

The Master of the Rolls, in giving judgment allowing the appeal, explained that the main ground of the defence was that the defendants in supplying themselves and their own tramways with electricity were not " supplying " within the meaning of Section 23 of the Electric Lighting Act, 1909. To " supply," it was said, meant supplying by one person to another, and involved a supplier and a supplied. Mr. Justice Eve, said his Lordship, had upheld defendant's contention, apparently against his own opinion on the authority of " The West Surrey Water Co. *v.* the Guardians of the Chertsey Union," but he (the Master of the Rolls) could not see that that case was one to govern the present case which was upon a different Act, and in which all the circumstances and provisions were different. The meaning of the word " supply " was the main question in this case, and that meaning must be governed by the circumstances and the context. By Section 23 of the 1909 Act it was provided that: " Where in any area a local authority, company or person is authorised to supply electricity under Act of Parliament, or under licence or Provisional Order granted under the Electric Lighting Acts it shall not, after the passing of this Act, be lawful for any other local authority, company or person to commence to supply or distribute electricity within the same area unless such supply or distribution is authorised by Act of Parliament or by licence or Provisional Order granted in terms of the Electric Lighting Acts." By Section 3 of the Electric Lighting Act, 1882, with which the Act of 1909 had to be construed, the purposes, both public and private, for which the local authority might supply electricity were defined, and by Section 4 the Board of Trade was empowered by Provisional Order to authorise any local authority to supply electricity for any public or private purposes within any area. In 1891 the defendants obtained such an order, but said that the order was quite unnecessary to enable them to provide electricity for their own purposes, and that where they were to provide electricity they were not acting under the provisions of the order at all. He (his Lordship) could not agree with that. Power was given to the defendants to supply electricity for public purposes, *viz.*—lighting streets—which was a supplying for their own purposes. And they also had the power under the order to break up streets and do other things which they could not do without the order. In the order the term " supply " was used in its most general sense, and not in the restricted sense of supplying a person distinct from the supplier. The defendants, his Lordship thought, in this case were supplying

energy under the powers of the order, and that the word "supply" could not have the restricted meaning of supply to some other person other than themselves. The defendants were, in his opinion, acting in violation of Section 23 of the Act of 1909, and the plaintiff was entitled to a declaration to that effect and, if necessary, an injunction. The appeal would be allowed, with costs.

Lord Justices Warrington and Younger concurred, and judgment was given by them to the same effect.

Nye v. Schweppes, Ltd., and the Metropolitan Electric Tramways, Ltd.

The hearing of this case began before the Lord Chief Justice and a special jury on March 21st and continued for several days. The plaintiff, who was a coach painter, of Hendon, was a passenger on one of the defendant tramway company's cars, which either ran into or was run into by a steam lorry owned by Schweppes, Ltd. The plaintiff was pinned beneath the lorry and he alleged negligence on the part of both defendants. The trial was a test action as to who was liable, a large number of persons having been injured in the accident. Negligence was denied by both defendants. Some evidence was given with regard to whether or not the tramcar left the track before or after the collision. An engineer (Mr. A. E. Watson) was called to say that in his opinion the sudden drastic action of the magnetic brake caused the car wheels to leave the track, but (in cross-examination) he said that he had never known a car to leave the track as the result of such application. The driver of the car said that he applied his brake to avoid a collision as he received a signal that the lorry was going to turn on to the tramline. The lorry struck the car and the two vehicles ran together for a few yards, then the car left the metals.

A great deal of evidence was given on both sides, in the course of which Mr. J. H. J. Troughton, technical engineer in charge of the Metropolitan Electric Tramway system, said that he had never known the application of the magnetic brake to bring a tramcar off the rails.

Mr. J. B. Hamilton, commercial manager of the City of Leeds tramway system, gave evidence to the same effect, stating that he had never known a tramcar to leave the line as the result of the application of magnetic brakes.

The jury, after about an hour's consultation, at about half past 7 o'clock, gave a verdict for plaintiff, awarding him £1,500 against the Metropolitan Electric Tramways, Ltd.

A stay of execution was granted on the usual undertaking, and, on his Lordship's suggestion, the tramway company agreed to forthwith pay plaintiff £100 on account of the damages awarded.

Leigh Corporation Prosecutes Itself.

At the Leigh Police Court on March 22nd, the Leigh Corporation Electricity Department was summoned for emitting black smoke for half an hour from the chimney stack at the Corporation's generating station. The town-clerk acted both as prosecutor and defendant, and pleaded guilty. A fine of 25s. was imposed.

Killeen v. Greystones Electric Light & Power Co., Ltd.

In the King's Bench Division at Dublin last week, an order was made, on consent, remitting to the County Court Judge, of Wicklow, the action brought by Peter Killeen, a ploughman, against the Greystones Electric Light & Power Co., Ltd., in which damages were claimed for personal injuries sustained by the plaintiff by reason of the alleged negligence on the part of the defendant company in leaving a lamp unlighted. The application to remit and consent was made for the defendant company by Mr. Wakely, B.I. Mr. D. H. O'Leary, solicitor, was for the plaintiff.

Marconi's Wireless Telegraph Co., Ltd., v. The Mullard Radio Valve Co., Ltd.

The Court of Appeal, consisting of the Master of the Rolls and Lords Justices Warrington and Younger, on Friday, March 23rd, delivered considered judgments in the case of Marconi's Wireless Telegraph Co., Ltd., *v.* the Mullard Radio Valve Co., Ltd., upon the appeal of the plaintiffs and the cross appeal of the defendants from the judgment of Mr. Justice P. O. Lawrence in the Chancery Division.

Mr. Justice Lawrence held that what the defendants had done did not constitute an infringement of either of the plaintiffs' letters patent, but that the defendants' attack on the validity of those two patents failed. He directed that the plaintiffs should pay the general costs of the action and the costs of the issue of infringement, and that the defendants should pay to the plaintiffs the costs involved by their attack on the validity of the letters patent of the plaintiff company. Hence the present appeal of the plaintiffs and the cross appeal of the defendants.

The Master of the Rolls, in the course of an elaborate written judgment, said this was an action in which the plaintiffs alleged that the defendants had infringed two patents of which they (the plaintiffs) were the registered owners: One granted to Henry Joseph Round, No. 28,413 of 1913, and the other granted to Michel Peri and Jacques Biguet, No. 126,658 of 1916. The defendants denied the infringement of either patent, and disputed the validity of both; the patents were quite distinct and required the consideration of different circumstances in each case. Round's patent was the earlier in date and far more important. It was a patent for the improvement of receivers in wireless telegraphy. Claim 3 of the specification was for "a vacuum tube containing a hot filament, a grid formed as a closed cylinder completely surrounding the filament, and a third electrode in the form of a cylinder surrounding the grid substantially as described." To appreciate the meaning of the specification, it was necessary to look at the state of things prevailing in the industry at the time of the invention and the kind of vacuum tube then in existence, in order to see what meaning a person who knew about those things would attach to the words used. He (the Master of the Rolls) took that as stated in the judgment of Mr. Justice Lawrence. Round had improved on von Lieben's patent by making the grid and the anode in the form of cylinders. He agreed with Mr. Justice Lawrence that the grid must be in the form of a closed cylinder, and the anode in the form of a cylinder, open or closed. The real question in the case was what the words "in the form of a closed cylinder" meant. Defendants' contention was that they meant "closed at both ends," the plaintiffs' that they meant "electrically closed." There was, however, no difference in the form of an electrically closed and an electrically open grid in the form of a cylinder; and that being so, it was idle to specify that the grid must be in the form of a closed one. In ordinary language "closed cylinder" meant one closed at both ends, and "open cylinder" one open at the ends. At the time when Round's invention was patented all the valves in use were what were called "soft valves," *viz.*, valves containing an appreciable amount of gas and the filament was generally a hairpin filament. Probably it was for those reasons that Round specified a grid in the form of a closed cylinder in the ordinary sense of the words. The physical separation of the spaces as contemplated by Von Lieben and effected by a grid in the form of a physically-closed cylinder was much less important in the case of a hard valve, free from gas, using a straight filament, the hottest portion of which was in the middle. He (his Lordship) thought that the words "closed cylinder" meant "closed" in the ordinary sense and the words "completely surround" pointed in the same direction. He could not accept the argument of Mr. Hunter Gray that the cylinder could not possibly be completely closed in the ordinary sense. On that construction there was no infringement of Round's patent, as the defendants' grid was a loosely-coiled wire, which could hardly be called a cylinder at all. Round's patent was, no doubt, a very useful invention, which very likely would have held the field if the use of soft valves had continued, but the introduction of hard valves had made it possible to produce the same result without employing the apparatus which was the subject of the patent.

His Lordship then briefly referred to Peri's patent, which he said was of much less importance, and with regard to which he said he was in entire agreement with the judgment of Mr. Justice Lawrence that the claim there was an exceedingly narrow one. The defendants' valve completely differed from that of Peri. He thought that Mr. Justice Lawrence's construction of the specifications was the correct one and that the defendants had not infringed either of the patents. In the circumstances it was not necessary to consider the validity of either patent.

Lord Justice Warrington also delivered a long written judgment to the same effect. He agreed with the judgment of Mr. Justice Lawrence that the defendants had not infringed either of the plaintiff's patents, and he also agreed with the learned judge on the issue of validity.

Lord Justice Warrington read the judgment of Mr. Justice Younger to the same effect and accordingly both appeals were dismissed.

It was arranged that the question of costs should be argued on the first day of the next sittings.

Mica & Asbestos Insulating Co., Ltd., v. Fellows Magneto Co., Ltd.

This case was the appeal of the defendants in the above action (reported in our issue of December 29th, 1922) from the judgment of Mr. Justice Coleridge, awarding plaintiffs £2,203 11s., and costs, and at the same time dismissing a counterclaim by the defendants. The point at issue was whether certain mica disks and plates supplied by the plaintiffs for use in the construction of magnetos were according to specification, or defective. The judge found that although some of the goods were not according to sample, there had never been any reluctance on the part of plaintiffs to rectify any deficiency.

Before the Court of Appeal, consisting of Lord Justices Bankes, Scoutton, and Younger, on March 26th, the evidence was re-submitted, and, in the result, their Lordships ordered a new trial by an Official Referee. They decided that respondents should bear the cost of the appeal, but that the cost of the first trial should abide the result of the new trial.

PARLIAMENTARY NOTES.

[By Our Special Parliamentary Reporter.]

Broadcasting.—On March 20th, Mr. Moore-Brabazon asked the Postmaster-General if he had any control over the quality and selection of items that were broadcast; was he aware that French stations were better than the English.

Sir W. Joynson-Hicks said the licence issued to the British Broadcasting Co. provided that satisfactory programmes of broadcast matter should be maintained. He was not aware that they were inadequate or inferior to those transmitted from French stations.

Mr. Moore-Brabazon also asked the Postmaster-General if he was aware that the North Foreland radio station prohibited everyone in East Kent from hearing London broadcasting.

Sir W. Joynson-Hicks said the North Foreland station did not send out untuned waves. It worked on a tuned-wave of 600 metres; its power was not excessive for the services which it had to perform; and it was equipped with all suitable apparatus for minimising interference. Its maintenance was important from the point of view of international obligations with regard to communication with ships, and in the interests of the safety of life at sea. He regretted that when North Foreland was communicating with ships in the Channel, interference was inevitable in the neighbourhood of East Kent.

The Marconi Licences.—On March 22nd, Mr. Middleton asked the Postmaster-General whether he would lay on the table of the House the terms of the temporary licences granted to the Marconi Co. to send, receive, and transmit public messages.

Sir W. Joynson-Hicks replied that no formal licences had been issued, but provisional permission had been given to the company to carry on radio services with France, Spain, and Switzerland. This permission was given by letter, and was subject to withdrawal without giving rise to any claim for compensation, if a suitable agreement was not come to between the Government and the company as to the conditions on which licences for such communication would be granted. Any agreement that might be arrived at would be laid before Parliament.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

An "Aster" Welding Plant.

The accompanying illustration (fig. 1) shows a semi-portable electric welding plant of convenient design, made by the Aster Engineering Co (1913), Ltd., Wembley, Middlesex.

The primary unit is a four-cylinder 18 to 20-h.p. "Aster" engine, vertical type, running at 1,100 r.p.m. This engine is fitted with the firm's standard governor, which has proved particularly suitable for the fluctuating loads experienced under arc welding conditions. The generator and the electrical equipment generally is made by the Metropolitan-Vickers Electrical Co., Ltd. The equipment is mounted on a substantial channel steel bedplate which is provided with forged steel uprights fitted with slinging eyes and superstructure so that the whole equipment may be readily slung for loading. Cooling is effected by the radiator seen in the illustration, and a suitable silencer is mounted on the far side of the engine.

The switchgear is mounted on a sprung frame to absorb any shocks experienced in loading or unloading.

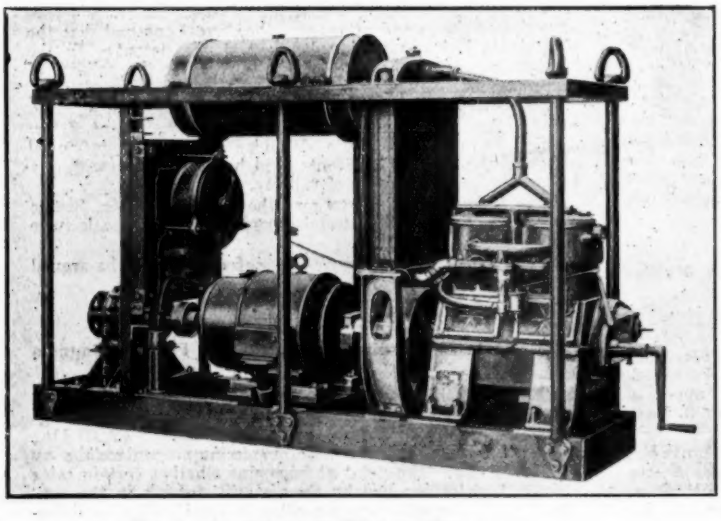

Fig. 1.—An "Aster" Welding Set.

The "Blandfield" Hot-water Circulator.

A hot-water circulator produced by the Blandfield Manufacturing Co., 70b, London Road, Croydon, possesses several points of novelty. It has a cylindrical copper body divided horizontally into a number of chambers, which extend to within a short distance of the outer wall of the cylinder. These chambers communicate with one another by means of "staggered" connections, the principal being that the heated water will not rise in a column to the top of the tank but pursue a zig-zag path through the whole of the water in the compartments. Into the spaces, between the latter, slide small trays containing the heating elements. The connections to the elements are made by bringing the supply wires up through channels at the sides of the front of the tank. A hinged door forms a cover which may be sealed. The tank is so designed, with a conical top, that it can be used in combination with another similar tank. Three sizes are made. These have, respectively four 500-W, three 1,000-W, and four 1,000-W elements.

Reduction Gear and Clutch.

We have recently received a description of a neat reducing gear and clutch (fig. 2) from the Parsons Motor Co., Ltd., of Southampton, and it would appear to be a very suitable device for use particularly with synchronous single-phase a.c. motors.

Practically no power is absorbed by the gear when running light, so that if the motor possesses the slightest starting torque, it can be run up to its full speed and be properly in step with the supply before the load is imposed.

The primary and secondary shafts are arranged coaxially and, therefore, the drive is taken in a straight line from the motor to the driven machinery, and while resulting in a speed reduction of 2½ to 1 and providing an efficient metal-to-metal clutch all the advantages of a direct drive are retained.

While the design of this mechanism does not permit a closer ratio than 2½ to 1 to be obtained, it is possible to arrange for various other ratios in the opposite direction, say, 3 or 4 to 1, &c.

This gear, which can be run in either direction, has a mechanical efficiency of approximately 98 per cent., and continuous and ample lubrication is provided by immersion in an oil-tight case.

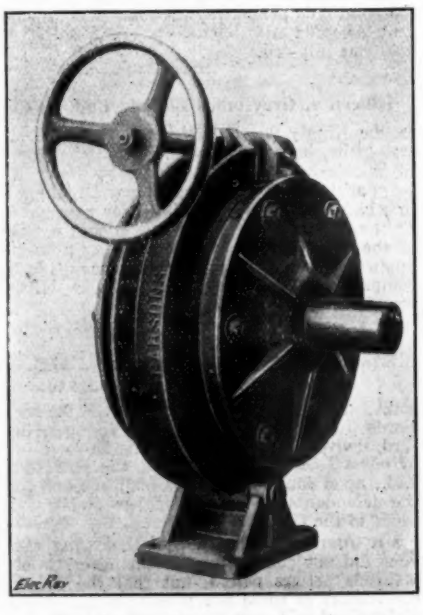

Fig. 2.—Reduction Gear and Clutch.

An Insulated Wire Stripper.

The Canadian *Electrical News* states that Wallace G. Grossman, 79, Walker Street, New York City, is manufacturing a small machine for stripping the insulation from conductors. It is made to fix on a bench in shops where a quantity of wire single and twisted, stranded wire and cord is handled. A motor-driven knife with a continuous action cuts the insulation from the wire, and also twists the copper strands. The knives are adjustable to sizes of wire varying between wide limits even while the machine is in operation. The main shaft is supported by a ball bearing.

CORRESPONDENCE.

Letters received by us after 5 p.m. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The E.I.T.A. and the Broadcast Wireless Scheme.

With reference to the letter of the Secretary of the Electrical Importers' and Traders' Association, I am afraid that it is rather difficult to understand what the writer means, but as I understand it, he appears to wish the electrical contractors of the country to take action to support the *import* of foreign manufactured articles, and this is not, so far as I am aware, what British electrical contractors wish to do.

With respect to wireless apparatus, as far as I understand, the Postmaster-General only allows British-made wireless sets to be used in connection with broadcasting, and I hardly see what exception anyone can take to this.

Speaking from the point of view of one who has been in business a long time, I have never yet found the foreign importer very eager to see that the electrical contractor was in any way protected, and if any electrical contractor wants to remain in business he had better do as I do; that is, support British firms, as he has nothing to gain by buying imported goods at all.

The question of protection was always a difficult one, but there is no doubt that the present times make it imperative that we should support British-made goods.

R. Falshaw.

Harrogate, *March 21st*, 1923.

Rating Terminology.

On reading the specifications of rival manufacturers of electric motors, one maker described his rating as "liberal," whilst the other advertised his machines as "conservatively" rated. Being a novice in these matters I asked a friend, who is associated with one of the firms, which of these claims might be dependable, for it struck me that liberality stood for generosity, whilst the conservative savoured of giving only what might be necessary, and no more.

My friend (who is a sales engineer) snatched the offending document from my desk and muttered something about crossheads or "fatheads," and with great wisdom remarked that whilst the first description might be the more intelligent, the second one might easily be the more truthful. I am still in doubt which of these makers should be blackballed.

I have since heard that my friend wrote his firm asking why the goods they produced were branded as conservative, whereas rival goods were described as liberal. His letter was returned bearing the cryptic legend: "Try the labour party," scrawled thereon in red pencil. Now, both my friend and myself are puzzled, particularly as this illuminating instruction comes from Manchester.

Will any of your cool-headed readers be good enough to comment upon this juggling of terms, or answer the conundrum: "When is liberal conservative?"

This is a true story.

Simplon.

March 21st, 1923.

Fair Trading—A Lesson from the Gas Industry.

An incident has just come to my notice which shows the close co-operation between manufacturers and retailers in the gas industry, and how the former realise that their interests can best be promoted by fair trading.

A friend from this town made some inquiries about a special type of geyser at the manufacturers' stall at the Ideal Home Exhibition, concluding by requesting a catalogue. After a cursory glance around, the salesman expressed his regret that he had not one left, but said he would be very pleased to send one by post. Whether or not this was merely a simple ruse to get the consumer's address is immaterial, but the sequel is interesting: Only three days later a representative of the local gas department called on my friend, bringing with him the promised catalogue, and showed himself fully conversant with the geyser in question. A sale will probably result.

One wonders how many electrical manufacturers—say in the wireless section of the exhibition—would have adopted this course. It is to be feared that the vast majority would have been only too anxious to secure the sale *direct* instead of through a legitimate dealer, making use of that all-too-popular, but very weak, argument that if they did not some other manufacturer would secure the order, and, incidentally, showing how little faith they have in the merits of their own manufactures.

There is little doubt that the newest branch of our industry—that controlled by the N.A.R.M.—is the worst offender in this respect, but until the question of electrical sales can be dealt with as a whole and efforts made to reconcile the interests of manufacturers, factors, and resellers in every branch of the industry, the existing chaos and its abuses must continue. This being by far the most vital matter before the industry, surely it should be tackled by the I.E.E., as it is far too large and complex a matter to be dealt with by any individual sections.

E. Arthur Pinto.

Ramsgate, *March 19th*, 1923.

Changing-over Networks from D.C. to A.C.

As another engaged on this work I have been very interested in the articles and correspondence on this subject. May I also ask one or two questions:—

1. Has the consumer the legal right to insist on any particular make of motor being put in in place of his existing d.c. motor, or is the choice left to the supply authority?
2. If the consumer has a 10-h.p. motor which is only loaded to 5 h.p., can he insist on the new a.c. motor being of 10 h.p., or may the motor be of a size suitable for the work it is to perform?

This seems to be of importance when many motors have to be changed on a network, on account of the question of power factor.

S. G. M.

March 19th, 1923.

Appointments Vacant and "Un-Employment."

As one who has been "Un-Employed" for many months now through no fault of my own I should be obliged if some of my brother "Un-Employed" would kindly give me a little advice on what is the usual procedure adopted when one is called up for an interview. Is it usual for the advertiser to pay railway fares or not? I have been called up by large firms who have also paid the fares.

Last week I replied to a "Box No." and received a letter asking me to call. I at once wrote and asked if my fare was to be paid (I might here say that I do not possess 2s. in the world of my own); I received the following wire: "Under the circumstances stay at home. Sorry." I am afraid that the poor unfortunates who are un-employed and reside in the provinces do not get an earthly chance of a job owing to the distance. I have during six weeks sent out 89 applications.

I would suggest that the following rule should be adopted: If the applicant gains the position, he pays his own fare; if he is unsuccessful, the advertiser and the applicant equally share the cost.

I should be glad to hear your views on the above subject.

A Genuine Un-Employed without the "Dole."

March 24th, 1923.

Radio-Station Towers and Masts.—In the design of radio-station towers and masts, the maximum wind pressure and the law connecting the pressure with the height above the ground are of primary importance. Mr. C. F. Elwell, in a recent paper before the Wireless Section of the Institution of Electrical Engineers, reviewed briefly the results of past experiments, and endeavoured to point out what are safe and economic values of wind pressure for design purposes. The need for the standardisation of wind-pressure assumptions was also emphasised. The variety of specifications employed in the past proves a considerable difference of opinion to exist, *i.e.*, from 15 to 112 lb. per sq. ft. In radio mast and tower design the load due to the wind is the chief load. Masts when unloaded are held vertical and designed to lie in a straight line, or as an arc of a circle when fully loaded. A wrongful assumption as to wind-pressure distribution from the top of the structure to the bottom can readily upset the designer's calculations as to the position which the mast will take up in a gale.

In order to appreciate the economic waste which is present in employing 60 lb. per sq. ft., for example, over the entire height of an 820-ft. mast, as opposed to a graded wind pressure of from 27 to 59 lb. per sq. ft., the comparative quantities of structural steel, stay wire, and concrete have been calculated. If, as is very possible, the assumption of 27 to 59 lb. per sq. ft. should be excessive and one-half of these values be sufficient, then a further possible saving is also shown.

	60 lb.	27-59 lb.	13·5-29·5 lb.
Structural steel	128	100	75
Stay wire	140	100	50
Concrete	155	100	50

We have no definite knowledge of how wind pressure, especially high pressure, varies with elevation, but it seems clear that it is not the same at the ground as at, say, an elevation of 1,000 ft., and the evidence points to the top pressure being more than double the pressure at the ground, so that it is not a negligible factor.

If no more data exist on this subject than have been brought out in this paper, it seems to indicate that we should attempt to gain this knowledge without delay, and if this paper should inspire any of the owners of high radio masts or towers to equip them with the necessary recording instruments with a view to filling a void in our knowledge, it will not have been in vain.

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A NEW TYPE OF DIRECT-CURRENT WATT-HOUR METER.

The well-known O'Keenan (O'K) direct-current ampere-hour meter of the unbraked motor type has been adapted to the measurement of watt-hours by a simple but ingenious device. In the ampere-hour meter of this type the motor armature is connected between the terminals of a low-resistance manganin shunt in the main circuit, and the speed of the armature is then proportional to the voltage drop in the shunt, *i.e.*, to the value of the current flowing in the main circuit. In the meter as modified for the measurement of watt-hours (*i.e.*, energy consumption), the general construction is the same as in the ampere-hour meter, but the armature is connected between two points at a difference of potential which varies with the watts consumed in the load circuit. The speed of the meter is then proportional to the watts, and the indication of the recording train is the true energy consumption, regardless of the constancy of the supply voltage (which is, of course, assumed to be constant in the calibration of an ampere-hour meter in kWh).

The connections of the modified meter are shown diagrammatically in the accompanying figure, reproduced from the *Revue Générale de l'Electricité*. Instead of connecting the motor M across the terminals of a plain shunt A B, as in the ampere-hour meter, a branch circuit A C, C B is connected between the terminals A B of the main shunt. The wire A C is of material which varies slightly in resistance with changes in temperature, but C B is of nickel, and therefore increases rapidly in resistance as its temperature rises. The resistances of the wires A C, C B are made practically equal when the main circuit supply voltage is normal. A fine-wire heating coil H of constant resistance is wound on a mica tube, about 5 mm. diameter and 3 cm. long, surrounding the wire C B. A larger mica tube, 1½ to 2 cm. in diameter, surrounds the heating coil and serves to reduce and stabilise the loss of heat by convection and radiation. The coil H, being connected between the points N and B, is traversed by a current which is proportional to the supply voltage U. At normal voltage the heating coil and the nickel wire C B attain a temperature of about 150 deg. C.; when tested (by the makers) at twice normal voltage the temperature reaches 600 deg. C., which is still well below the temperature at which oxidation or other deterioration ensues.

The motor M is connected between the point C and a point D on the shunt A B, which is roughly four-fifths of the length of the latter away from A. The current taken by the motor is very small (of the order of 1 mA), and does not appreciably affect the conditions in the circuits A B, A C B (where the current is of the order of amperes). It can be shown that the

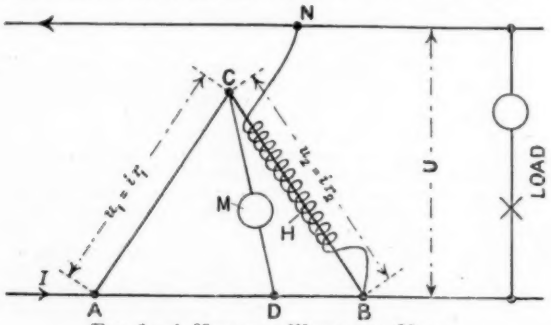

Fig. 1.—A New d.c. Watt-hour Meter.

p.d. between C and D in the circuits thus arranged varies with the product of I by U, *i.e.*, with the watts consumed by the load.

It may be objected that the current i in the circuit A C B, traversing the nickel wire C B, will cause a change in the resistance r_2 of the latter, which will falsify the results. In order to eliminate this potential source of error, the wire A C is made of material having a much lower temperature coefficient of resistance than nickel. The potential difference u_2 ($=ir_2$) can thus be made constant.

There is a certain time lag in the action of the meter when subjected to sudden variations of supply voltage, but the errors due to this cause are small and, under practical conditions, cancel out as the voltage rises and falls.

Compounding, to compensate for the very small amount of friction in the meter, is obtained by connecting in series with the motor between the points C D a constantan-iron thermo-couple heated by the coil H. The e.m.f. of this couple (of the order of 1 mV) develops a driving torque which compensates completely for friction. This method of compounding has the advantage that there is no electrical connection between the pressure and current circuits, and the meter is subjected only to a p.d. lower than 0.5 V, as in the ampere-hour meter of the same type. Low as this voltage is, the pressure available to cause sparking at the commutator is much lower, due to the relatively high back-e.m.f. of the unbraked armature. It is estimated that the maximum power available for sparking is about eight micro-watts; experience shows that the commutator in the O'K ampere-hour meter is not appreciably deteriorated by years of service, and the commutator conditions in the new watt-hour meter are the same. The maintenance required is no greater than that needed by induction-type a.c. meters.

The high intensity of the magnetic field in which the armature rotates prevents the meter being affected by stray fields. High accuracy is obtained at low loads because of the high driving torque (25 grm.-cm. in the 1½- and 2½-kW meters), the small diameter of the commutator (1.8 mm.), and the small weight of the rotor (79 grm.). Temperature error is inappreciable. The power consumption in the pressure circuit is about 2.7 W at 110 V, but can be halved whilst still retaining a driving torque exceeding 0.07 grm.-cm. per grm. weight of moving parts.

The general construction of the new meter is identical with that of the ampere-hour meter, save for the addition of the heating coil and the use of the special shunt circuit. In order to facilitate mass production, the shunt A B in the accompanying figure is not actually connected in the main circuit, but is standardised for a total current (in A B and A C B) of 2A (maximum load), and is used in conjunction with a main circuit shunt, the value of which is selected to suit the range of measurement required; in the largest meters the drop across the main shunt does not exceed 0.1 V. This does not modify the general principle of operation of the meter, and the latter is naturally calibrated to read directly the energy consumption of the load.

It is claimed that the new meter is equally suitable for use in circuits consuming up to 1½ or 2½ kW at 110 V and for central station or industrial circuits carrying, say, 18,000 A at 500 V. The meter has been sanctioned officially for use in France, and tests on a 2,750-kW, 275-V meter of this type showed that with 20 per cent. voltage variation (250 to 300 V) the accuracy varied only from 98 to 101 per cent. and the meter started at 1/600 of full load. At normal voltage the accuracy ranged from 98.7 to 100 per cent. between 1/200 of full load and full load.

THE SPRAGUE SYSTEM OF AUTOMATIC TRAIN CONTROL.

Our American contemporary, the *Railway Review*, recently devoted considerable space to a new system of train control which is being tested on the New York Central Railroad. This system was devised by the president of the railroad, Mr. F. J. Sprague, and the experimental engineer, Mr. F. D. Sprague.

The system is of the intermittent induction type with permanent track magnets. It comprises automatic stop, graduated speed control, and cab-signal apparatus. It is designed to control both steam and electric trains operating over the same track, and it makes use of measured light and heavy braking, with variable speed control. Normally, manual release of the brakes is provided for, but, if required, also with co-operative release from the track in case the automatic braking has taken place after receiving a second impulse in a block. Briefly stated, the system provides for train protection by a combination of visible, audible, and touch-responsive cab signals, with manually-controlled automatic primary service and speed-and-brake controlled secondary service, or emergency brake applications, in response to magnetic impulses received from magnets located in each block. In every completely-equipped block there are two normally active brake-application magnets with neutralising coils on the working poles, and one clearing or re-set magnet with energising coil. To neutralise the field of the working poles of the brake-application magnets, current is sent through the coils reducing to a negligible amount or reversing the free field above them, but not affecting the total flux in the permanent magnets. When thus neutralised, the receivers on a passing locomotive are unaffected, for the block is clear. Failure of the neutralising current automatically restores the track-magnets to a normal-danger condition. Under normal conditions no current is used on any of the track magnets when the track is clear, and current is used on the group of three magnets in each block only when a train is passing through the block and the next block in advance is clear. The average total energy required on a division is one kilowatt for each eighty engines in service. The re-set magnet is a plain electro-magnet with poles similar to those of the application magnet. It is situated near the end of the block, and its function is to restore certain selective relays on the locomotive to their normal position when they have responded to one or more brake-application impulses, and if the energising circuit fails it will not clear. The restoration of relays to normal condition does not affect the brakes, which are always manually released. The magnets may be installed regardless of the system of propulsion—steam, or electric third rail or overhead supply—and are not adversely affected by either direct or alternating current.

Each locomotive carries a receiver of a neutral magnetic type, without induction coils, in which two detector contacts are operated directly by the magnetic flux appearing in the gaps separating the corresponding parts of the receiver when passing through an active magnetic field. The flux receivers are attached to the under side of a non-magnetic box, through holes in the bottom of which movable upward-projecting tips extend from the flux plates. Within the box are mounted, on an insulating base, two light spring contact arms which complete the magnetic paths between a set of three laminated segments, through holes in which extend the magnetic tips. These are not only free to slide horizontally on the flux plates, but also to move vertically in the laminated plates. The contact governing the application of the brakes is normally closed, and its opening initiates the braking movement, while the re-set contact, although normally closed prior to any brake application, is afterwards in an open position, and must be closed to establish a re-set condition. Dependence is placed upon "interval" instead of "time" spacing, and the brake applications are primarily controlled by three interlocking relays—primary, secondary, and re-set—in series with the contacts in the locomotive receivers and operating in conjunction with other contacts under the co-ordinated control of train speed and manual braking. The relays are of the single-coil type mounted on a common base, and each has two reluctance gaps in series which are spanned by gravity- and spring-retracted armatures making self-centring pressure contact only. The two armature contactors, being of similar electrical connection, are joined, and since the reluctance gaps are in series, the making and breaking of the two contacts are practically simultaneous. The normal circuit connections are permanent, but the relay, as a unit, may be replaced in a few seconds. Provision for current supply is made from two sources—a 12-V storage battery carried in a protecting box, and the normal 32-V headlight generator.

Two light indications are given. Ordinarily when running above the low-limit "proceed" speed a green light only is visible indicating that the advance block is clear, but on passing an active distant magnet this light goes out, and an audible warning is given. If the speed is less than the low-limit fixed, a yellow "proceed" light appears, but if the speed is greater this light goes out unless the braking is properly co-ordinated with the increased speed. When the train has been braked the proper amount, either manually or automatically, before reaching the "home" magnet, or the train speed has been reduced to the low limit permitted, the yellow "proceed" light will again appear, indicating safe conditions for passing a live "home" magnet without a secondary automatic brake application. The lights are duplicated on the fireman's side. They are merely indicative, and no part of the control apparatus is dependent upon them.

Special provision is made for speed controls on tangents and dangerous curves without interfering with the manual operation.

BUSINESS NOTES.

Bankruptcy Proceedings.—John Kaine Fish, Sempolia, West Green Road, Tottenham, London, N., late Etherley Road, wireless instrument maker.—The receiving order in this matter was made recently on debtor's own petition. The statement of affairs shows liabilities of £195, against assets of £31, or a deficiency of £164. Debtor attributes his failure to lack of capital, ignorance of business methods, and depression in trade. It appears that he was employed in the electrical engineering business, and in July, 1921, commenced business on his own account, as J. F. Kaine, as a wireless instrument maker at Lordship Lane, Tottenham, with about £100 borrowed from relatives. The business progressed favourably, and for a time he had a working arrangement with another, with whom finally he entered into partnership in July, 1922. Debtor looked after the technical side of the business while his partner managed the financial side and kept the books. Difficulties arose a month or so later about meeting the liabilities, and at the beginning of October the partner took possession of the partnership assets and a sale by auction was held. Subsequently debtor took a workshop at 170, West Green Road, and commenced there alone as a wireless instrument maker as the Sempolia Wireless Co. Debtor states that proper books were kept in the partnership business and are in the possession of his partner. In his subsequent business he kept a cash book and a combined debtors' and creditors' ledger.

William Edward Weeks, 59, Victoria Street, and 12, Filton Avenue, Horfield, Bristol, wholesale electrical dealer.—The receiving order in this matter was made on March 13th on debtor's own petition. The statement of affairs shows liabilities of £1,693, against assets of £977, or a deficiency of £715. Debtor attributes his failure to slump in trade, bad debts and want of capital. It appears that after being employed by an electrical supplies company which went into liquidation, debtor on November 1st, 1920, took over the stock-in-trade, about £200, and office furniture at £90. He then commenced business as a whoesale electrical dealer at 59, Victoria Street, with about £50 capital in cash. The stock in trade was invoiced to him on the usual credit terms, and the £90 for the office furniture was payable by monthly instalments. Debtor states that after the first year, owing to depression in trade, his business was carried on at a loss. He states that he did not become aware of his position until two months ago.

Harold Parr, 2, Strawberry Dale Square, and 1, Back James Street, Harrogate, electrician.—The public examination of this debtor was held recently at the Court House, Raglan Street, Harrogate. The statement of affairs showed gross liabilities of £1,155, of which £814 was expected to rank for dividend, against assets of £670, or a deficiency of £144. Debtor attributed his failure to small profits owing to keen competition in business, bankruptcy of three book debtors, and pressure by creditors taking proceedings. It appeared that he commenced business as an electrical engineer three years ago at Back Mayfield Road, Harrogate. About twelve months ago he removed to 1, Back James Street. When he commenced business he had cash savings amounting to £32. He borrowed £50 from his father, and in July, 1921, a similar sum from another relative. For the first year of his trading a profit and loss account was kept, which showed a profit of £113. He stated that he had been losing money all the time he was trading. He continued in the hope that matters would improve. After further questions the examination was closed.

D. Bould, electrical engineer, Burn Croft, Birchencliffe, Huddersfield.—Receiving order made March 20th on creditors' petition.

T. S. Cartwright (T. S. Cartwright & Co.), electrical contractor, 90, Wellington Street, Stockport.—Receiving order made March 21st on debtor's own petition.

E. Cookson (W. Turnbull & Co.), automobile, electrical and mechanical engineer, Express Magneto Repair Works, Elizabeth Street and Charles Street, Blackpool.—First and final dividend of 5s. 2d. in the £, payable at the Official Receiver's offices, 13, Winckley Street, Preston.

Frederick Harold Thomas, and Walter Ernest Evans, trading as Thomas & Evans, Salubrious Place, Swansea, electrical engineers.—The adjourned public examination of these debtors was held recently at the Town Hall, Swansea. Debtor Evans stated that the amended statement of affairs showed an increased deficiency of £3,137. Thomas said that the business was in difficulties when he joined the army, and on his return they had liabilities of £2,000. After further questions the examination was closed.

Company Liquidation.—Pearsons (Electricians), Ltd.—A meeting of members is called for April 23rd at 27, Brazennose Street, Manchester, to hear an account of the winding up from the liquidators, Mr. W. Eaves and Mr. A. Yearsley.

Dissolution of Partnership.—Shaw & Smallshaw, 14, Legh Street, Warrington.—Mr. H. Smallshaw and Mr. A. H. Shaw have dissolved partnership. Debts will be attended to by Mr. Shaw, who will continue the business on his own account.

Trade Announcements.—The Salisbury Electric Light and Supply Co., Ltd., has opened new offices and showroom premises at 27, Market Place, Salisbury.

The Rex House Wireless Co., of Glasgow, has opened a branch business in Cadzow Street, Hamilton, under the management of Mr. James P. Brown.

The Hillbar Press has removed its city office to the works at 473, High Road, Leyton, E.10 (Telephone No. "Maryland 1746,") and all correspondence should be addressed there.

Mr. T. J. Andean, A.M.I.E.E., who quite recently left the Ebbw Vale Steel, Iron & Coal Co., Ltd., with which he had been chief electrical engineer, has joined Mr. E. Spencer Stevens, of Bristol, in partnership as electrical engineers and contractors, at 87, Cotham Brow, Bristol. Messrs. Stevens and Andean desire to receive catalogues of electric lighting plant, signs, electrical accessories, radio apparatus, &c.

Electrical Installations, Ltd., now associated with Wireless Service, Ltd., of 2, Lower John Street, Piccadilly Circus, W., and its wireless department will be worked by that company, in which it is interested financially and in other ways.

Catalogues and Lists.—Economic Electric, Ltd., 10, Fitzroy Square, W.1.—A price list of complete radio-telephony receiving sets, parts and accessories. Illustrated.

British Insulated & Helsby Cables, Ltd., Prescot, Lancs.—A brochure upon the "Prescot" wiring system, illustrating many examples of buildings in which it has been installed.

Engineering Supplies, Ltd., 155a, Upper Thames Street, E.C.4.—An illustrated and priced leaflet advertising "Eagle" crystal and valve broadcasting receivers.

The Globe Engineering Co., Ltd., Brighouse, Yorks.—List No. 6, a leaflet illustrating a 1-b.h.p. motor. Priced.

The Siluminite Insulator Co., Ltd., The Green, Southall, Middlesex.—Two illustrated leaflets illustrating the application of "Siluminite" to switchboard panels and third rail insulators.

The Phœnix Engineering Co., Ltd., Chard, Somerset.—An illustrated list of pumps, tar-spraying machines, asphalt cookers, tar boilers, &c.

Mr. H. Rhodes, Keswick.—Monthly price sheet of electrical materials and accessories, including cables, wires, conduit, switches, cut-outs, &c.

The "Argson" Engineering Co., Ltd., Beaufort Works, Richmond Road, East Twickenham.—A number of illustrated leaflets dealing with hand-power and mechanically-propelled invalid tricycles.

Messrs. Lionel Robinson & Co., 3, Staple Inn, W.C.1.—A postcard illustrating and giving particulars and prices of "Ballsok" insulating beads.

The Benjamin Electric, Ltd., Brantwood Works, Tariff Road, Tottenham, N.17.—*The Benjamin Bulletin*, a publication "dealing with automobile matters in general and 'Benjamin' automobile products in particular."

Book Notices.—"Japanese Journal of Physics: Transactions and Abstracts," Vol. I, Nos. 1—6. Tokio: National Research Council of Japan.—This *Journal* gives in very concise form the results of researches carried out by Japanese physicists over a wide field. The subjects dealt with in the first number form an index to the character of the *Journal*; they include: "The Spectrum of the Brush and the Glow Discharges of Electricity"; "The Effect of Temperature on the Modulus of Rigidity and the Viscosity of Solid Metals"; "The Fundamental Equations of the Electron Theory"; "Dielectric Hysteresis and Allied Phenomena"; "Low Voltage Standard Cells"; "The Dependency of the Temperature-Coefficient of a Permanent Magnet on its Dimensions"; and many other abstracts.

The Radiogram and Wireless Answers, Vol. I, No. 1. London: Horace Marshall & Co.; price 3d. weekly.—This is the first number of yet another journal designed for the devotees of radio broadcasting. It is written in a "popular" style, and contains items of news and well-diluted technical matter. The articles in this issue include an interview with Mr. Arthur Burrows, of the B.B. Co. (with photograph); a description of the wireless exhibits at Olympia; notes on accumulators; and aids to the construction of receiving and transmitting stations.

Sir Isaac Pitman & Sons, Ltd., have issued a "Spring List" of their publications, both new and forthcoming. The subjects of the works are of a widely-varied nature, and many books on electro-technical matters are included.

"The Spectroscope," by T. Thorne Baker. Pp. x+208; figs. 94. London: Baillière, Tindall & Co. Price 7s. 6d. net.

"*Journal* of the American Institute of Electrical Engineers," Vol. XLII, No. 3, March, 1923. New York: The Institute. $1.

"Socialism: Its Fallacies and Dangers." A collection of papers, edited by F. Millar. Pp. 80. London: Watts & Co. Price 1s. net.

"A First Course in Heat Engines," by J. W. Hayward. Pp. 271; figs. 143. London: Universal Tutorial Press, Ltd. Price 4s.

"Wireless Component Parts and How to Make Them," by B. E. Jones. Pp. 124; 208 figs. London: Cassell & Co. Price 1s. 6d. net.

"Atoms," by Jean Perrin. Pp. xv+231; 16 figs. London: Constable & Co., Ltd. 8s. 6d. net.

"The Golden Hammer and other Engineering Stories," by A. W. Marshall. (188 pp.) London: Percival Marshall and Co. Price 3s. 6d.—This book contains nine reprinted stories which, the author states, are meant "to foster hope and encouragement, sympathy, and habits of industry and understanding," and a host of other virtues, which proves that the spirit which inspired "Sandford and Merton" is not dead.

A Central European Glow Lamp Syndicate.—A new company has been formed at Munich under the title of the Central European Glow Lamp Syndicate, which is said to stand in close relations with the Dr. Just Glow Lamp Co. of Budapest. The Osram Co. of Berlin (the lamp works of the A.E.G., the Auer Co., and of Siemens & Halske) now threatens to take proceedings for infringement of patents, it is alleged, as soon as any lamps on the Just system are placed upon the German market.

Australian Tariff Decisions.—The following tariff decisions have been approved of by the Customs Department:—Electrical appliances and materials.—Insulating beads, porcelain. Item 404, free under the British preferential tariff, free under the intermediate tariff, 10 per cent. under the general tariff. Machines, machinery &c.—Magnetos for use in the manufacture of motor gang cars for railway purposes. Item 404, free, free, 10 per cent.—*Reuter's Trade Service* (Melbourne).

Bills of Exchange in Jugo-Slavia.—The Commercial Secretary in Belgrade has transmitted to the Department of Overseas Trade a memorandum, prepared by Mr. Vladimir Dusmanic, a Belgrade advocate, dealing with Serbian bills of exchange. These are given special value as instruments of payment, and there is a great deal of legislation governing their preparation and use.

Electricians' Wages.—The West-Midland District Industrial Council for the Electricity Supply Industry announces that the next wages revision in accordance with the national agreement, due to operate from April 1, will be based upon the average of the index figures of the cost of living published in the *Labour Gazette* for the preceding quarter, and will entail a reduction of a halfpenny per hour for adult workers, 1s. 4d. per week for youths, and 9d. per week for boys. An electrical fitter who was paid 2s. 1d. per hour under the agreement of July, 1920, will from April 1st receive 19.14d. per hour as the result of the latest reduction.

Sweden and Trade with Russia.—Among the few foreign firms who were represented at the Trade Fair which has just been held at Kieff are mentioned the names of the Swedish Ball Bearings Co., and the Alfred Vestrem Co., which produces appliances for the sugar industry, while the Swedish General Electric Co. was also to have been an exhibitor.

Spanish Trade with South America.—As a result of the growing interest that has recently been evinced among manufacturers in Spain regarding the extension of overseas trade, a Congress has been called of representatives of Spain and of the Spanish-speaking republics of South America, who are to meet shortly in Madrid, Seville and Barcelona. The object of the Congress (according to the Madrid correspondent of the Anglo-South American Bank) is to draft a programme for the development of trade, with a view to finding an outlet for Spanish products. Among the proposals which will probably be adopted by the delegates are the appointment of competent commercial advisers to every embassy and legation abroad, and the establishment of direct shipping communication between the western coast of South America and Spain, which has hitherto been almost entirely lacking. The King and the Government are taking a great interest in the Congress, the inaugural assembly of which will be presided over by His Majesty.—*The Bulletin of the F.B.I.*

Continental Exhibitions.—Italy.—We have received from the Italian State Railways (State Tourist Department), 12, Waterloo Place, Regent Street, S.W. 1, a pamphlet containing particulars of the special arrangements which are being made for the benefit of British visitors to the Milan Samples Fair, being held from April 12th to 27th. Details of fares and hotel accommodation are imparted, and the pamphlet also contains general information regarding the Fair.

Portugal (*Lisbon*).—The Minister of Commerce is engaged in the organisation of the International Fair to be held at Lisbon in November.—*Reuter's Trade Service* (Madrid).

Trade Exhibition at Glasgow.—At the recent Bakers', Grocers', Confectioners', and Allied Traders' Exhibition in Glasgow, there were many exhibits of machinery in operation, including installations of baking appliances. Among the latter was the Metropolitan-Vickers Electrical Co.'s "Westinghouse" electric baking oven, which was shown by the Corporation Electricity Department. The oven, which has been in successful operation in America for some time, is of the reel type, a series of eight shelves revolving inside the oven. The heating elements are fixed at the bottom of the oven. The control is very simple. Automatic electric toasters for restaurant and hotel use were also shown, while demonstrations of domestic electric cookers attracted much attention.

A great variety of appliances for cooking purposes was shown by Messrs. W. M. Still & Sons, of Hatton Garden, London, including electric cooking utensils in copper, steel, and aluminium.

Birmingham Trades Exhibition.—The National Trades Exhibition was opened at Birmingham last week by the Lord Mayor, and it will be continued for two months. The trade stands are of a most varied kind. There are exhibits of the latest cooking, heating and lighting equipment, furniture and furnishings, novelties and labour-saving devices. Upon the stand of the Birmingham Electric Supply Department a number of the leading firms in the trade display examples of their manufactures, particularly electric light fittings, which are of the most artistic design, and electric cooking and heating apparatus. The following firms are exhibiting: Metropolitan-Vickers Electrical Co., radio receiving sets and loud speakers, as well as fires, toasters, fans, and other household appliances; the General Electric Co., Ltd., radiators, electric motors, electric drills, &c.; the British Thomson-Houston Co., Ltd., electrical fittings in great variety; the Hobart Manufacturing Co., Ltd., electrically-driven potato-peeling machines, coffee grinders, sausage machines, &c.; Messrs. Veritys, Ltd., industrial lighting fittings and electric motors; British Brass Fittings, Ltd., artistic fittings and electric fires; Edison Swan Electric Co., Ltd., electric heating and cooking apparatus, lighting fittings, vacuum cleaners, and accumulators and batteries for radio sets; Callender's Cable & Construction Co., Kalanite insulation, house service cut-outs, colliery lighting accumulators, telephone cable, &c. Mr. G. Page, of Birmingham, shows a variety of electrical apparatus, and he also exhibits a complete loud-speaking equipment, which is demonstrated daily. Crystal and valve sets are exhibited by the Electrical Trades Supply, Ltd., of Britannia Works, Birmingham; electrical vulcanisers, by Mr. L. J. Beard, of Prospect Road, Birmingham; and a vacuum cleaner is displayed by the Electric Appliances Co., of London.

For Sale.—By direction of the Disposal Board, Messrs. C. A. Tricks & Son will sell by auction, on April 11th and 12th, at Horfield, Bristol, and the Quedgley Depôt, near Gloucester, electric motors, generators, plant, electrical material, lamps, &c. (See our advertisement pages to-day.)

E.D.A. Activities.—One of the latest pamphlets (E.D.A. 384) published by the British Electrical Development Association, reproduces authoritative refutations of the statement, recently given much prominence in the lay Press, that the electric lamp emits ultra-violet rays, which injure the sight. It is shown that none of these rays can penetrate the bulb of the lamp.

Another publication (E.D.A. 353) deals with the employment of electric motors in the textile industry, putting forward testimony from manufacturers and other authorities of the beneficial effect of the electric drive upon production.

Track Insulator Contract.—We are informed by the Siluminite Insulator Co., Ltd., that it has secured an order from the London Electric Railway Co. for the track insulators required in connection with the Golder's Green-Edgware extension. The L.E.R. Co. has used "Siluminite" for a number of years.

New Belgian Companies.—The formation of the following new Belgian companies is announced:—Comptoir Belge d'Exploitations Electriques (14, Rue Jacques de Lalaing, Brussels); Comptoir Général des Sciences Appliqués (Rue de la Croix de Fer, Brussels); Société Centrale d'Electricité et de Construction (Rue de la Victoire, Brussels); Société Générale Electro-Mécanique J. Laroche et Cie. (Boulevard du Midi, Brussels); and Lignier et Cie. (10, Rue de Pont Neuf, Brussels).

Electric Locomotive Construction in France.—Some large contracts for the construction of electric locomotives are at present in progress in France. La Société des Constructions Electriques de France, which has lately completed an order for 6[illegible] for the Midi Railway Co., has just received a further contract for forty engines for the Montrejeau-Pau section of the same railway. The joint concern known as the Société d'Etudes pour l'Electrification des Chemins de Fer, which comprises the Ateliers de Construction du Nord et de l'Est, and the Schneider and Thomson-Houston companies, has also lately received orders for eighty electric locomotives for the Paris-Orleans Railway Co., and thirty for the Paris, Lyons and Mediterranean Railway.

British Trade Mark Applications.—The following are included among the recent applications for British trade marks. Objections may be lodged within one month from the dates mentioned. In the case of foreign applications the names and addresses of the British representatives are also given.

Difsor. No. 431,941. Class 8.—Loud-speaking instruments or sound amplifiers used in telephony, wireless or otherwise. Compagnie des Machines Parlantes Pathé Frères, 30, Boulevard des Italiens, Paris, France. (Fell & James, 11, Queen Victoria Street, London, E.C.). March 21st, 1923.

Singer-Sewing Motors (lettering and design). No. 432,358. Class 6. Electric motors for sewing machines and parts thereof. No. 432,357. Class 8.—Rheostats, electrical resistances, and controlling switches for electric motors. Singer Manufacturing Co., 149, Broadway, New York, U.S.A. (Cruickshank & Fairweather, 62, St. Vincent Street, Glasgow). March 21st, 1923.

Leolite (lettering and design). No. 432,530. Class 6.—Internal-combustion engines and dynamos for use in the generation of electricity. Leo Sunderland & Co., Ltd., 40, Albemarle Street, London, W. March 21st, 1923.

Telechron. No. 432,940. Class 8.—Transmitting and receiving instruments for use in electric recording and signalling systems. William Clark, 53, Victoria Street, Westminster, S.W. March 21st, 1923.

Chrystagog. No. 433,055. Class 8.—Instruments and apparatus for wireless telegraphy and telephony. Alfred Roswell, trading as Roswell & Co., 28, Woodbridge Street, Clerkenwell, London, E.C. March 21st, 1923.

S.E.A. Electrodes (lettering and design). No. 430,071. Class 13. Electrodes for electric welding made principally of ordinary metal. Shipbuilding & Engineering Appliances Co., Ltd., 24, Grainger Street West, Newcastle-on-Tyne. March 21st, 1923.

Esla. No. 430,905. Class 13.—Electric switches, fuse connectors, &c. Haydn T. Harrison, trading as the Electric Street Lighting Apparatus Co., The Foundry, Whitehorse Lane, Canterbury. March 21st, 1923.

Window-dressing Awards.—The following is the result of the window-dressing competition arranged by the General Electric Co., Ltd. The maximum points were 50:—First prize, Robson & Colman, Newcastle-on-Tyne, awarded 50 points; second prize, The Polar Electric Co., Birmingham, awarded 30 points; third prize, T. Barrett & Co., Sutton Coldfield, awarded 25 points; consolation prizes, The Burnley Electrical Maintenance Co., Burnley, 23 points, and Chas. Cooper, Stretford, 10 points.

Unemployment.—On March 12th, 1,302,800 persons were registered at the Employment Exchanges as being totally unemployed; this represented a reduction of 16,155 during the week. The total decrease since the beginning of the year has been 183,708—or just over 12 per cent.

Local Exhibition.—Wimbledon.—We give below a list of exhibitors at the above exhibition, to which we briefly referred in our last issue: The General Electric Co., Ltd., cookers, kettles, irons, and the "Blighty" washing machine; the Jackson Electric Stove Co., Ltd., electric cookers and heaters; Justus Eck & S. Brook, radio sets, egg boilers, &c.; Northern Steel & Hardware Co., Ltd., "Uranus" bed-warmer and vacuum cleaners; Electric Suction Cleaner Co., suction cleaners; Carron Co., cookers; Bower Electric, Ltd., radio apparatus; British Electric Transformer Co., "Tricity" cookers, flame fires, &c.; The Brompton & Kensington Accessories Co., Ltd., cookers; Metropolitan-Vickers Electrical Co., Ltd., "Cosmos" appliances, "A.B.C." washing machines, &c.; Hotpoint Electric Appliance Co., Ltd., "Aerobell" washing machine, cookers, irons, &c.; E. Brook, Ltd., electric motors; Dominion Machinery Co., Ltd., "Elliott" woodworking machines; and Whitehead Bros., electric fires, cooking and heating apparatus, &c.

Copper and Lead Prices.—Messrs. F. Smith & Co. report March 27th:—No change in electrolytic copper prices.

Messrs. James & Shakespeare report March 28th:—Copper bars (best selected), sheet and rod, no change; English pig lead, £29, 2s. decrease on last week's quotation.

German Contracts with the United States.—German interests are evidently bent upon buying in the United States for shipment to their customers in foreign markets, in fulfilment of foreign contracts, says *The Iron Age*, New York. In addition to numerous reports of American mills having been approached by representatives of German interests in the United States, one large Ruhr steel corporation has two agents in America, who are entrusted with the placing of orders for finished material for shipment to South America. It is believed that Hugo Stinnes, besides purchasing coal in the United States, will shortly endeavour to place orders for steel to ship to South American markets on contracts, in order that the present complication in the Ruhr shall not cause the loss of these markets that have been partly regained since the Armistice. Prior to the occupation of the Ruhr, German mills held contracts for shipment of semi-finished material to American West Coast consumers, and these contracts may account for a recent report of negotiations by German agents with a mill whose product is semi-finished steel.—*Engineering*.

Electrical Power Engineers' Association.—On March 24th a joint meeting of representatives of the E.P.E.A. and the employers' side of the National Joint Board was held at the Ministry of Labour, under the chairmanship of Sir David Shackleton. The result was that the parties agreed to remove the deadlock by resuming the meetings of the Board. The question of salaries at Halifax, the immediate cause of the recent crisis, will be considered at the next meeting of the Board.

LIGHTING AND POWER NOTES.

Ashby-de-la-Zouch.—Electricity Supply.—The Urban Council has decided to offer no objection to the application of the Midland Electric Light and Power Co. for an Order to supply electricity within the urban area. A similar action has been taken by the Rural Council.

Australia.—Brisbane.—The Metropolitan Electricity Board has been formed in Brisbane to supply a number of districts outside the town with electricity. Energy will be obtained from the City Electric Light Co., or the Brisbane Tramways Trust, and will be sold to consumers at 7d. per kWh.

New South Wales.—A conference of municipalities in the south coast district is to be held to consider a proposal to form a county council for the hydro-electric development of the Shoalhaven river.

Perth (W.A.).—The eleven months ended September 30th, 1922, was the first completed period in which electricity had been taken entirely in bulk from the Government power house at East Perth. The cost of the current purchased in bulk was £35,873, and the gross revenue was £142,626. After deducting the sum of £86,904 for expenditure during the period, a working profit of £55,722 remained. The energy sold for the period aggregated 10,391,564 kWh, equivalent to 11,366,000 kWh for 12 months. The number of connections increased to 16,793, or by 10 per cent., and the total length of lines is now 208.3 miles.—*Commonwealth Engineer*.

Victoria.—The Victorian Electricity Commission has spent up to the present £1,705,000. For the current year, 1922-23, £2,500,000 is required on account of capital expenditure. The original scheme has been extended, and now includes an auxiliary power station at Newport to cost £800,000, and the erection of a factory at Morwell to produce 96,000 tons of briquettes annually, at a capital cost of £400,000. The works near Melbourne and along the main transmission line are being pushed rapidly on. Parliament's sanction is required for the erection by the Commission of a high-pressure transmission line for the south-western district, and for the purchase of the North Melbourne Tramway and Lighting Co.'s undertaking. The first stage of the western district scheme will cost about £106,000, and the price to be paid to the North Melbourne Tramway Co. is £115,000. The Melbourne Tramway Board has taken over the tramway portion at a cost of £31,250. The electric light portion will be operated by

the Commission. The Government has authorised the erection of houses at Yallourn for employés at a cost of £224,000, which provides 200 tenements. This expenditure includes provision for staff and administrative offices, roads, water channels, footpaths, water supply, recreation hall, and electric light services. It is expected that the population will reach 3,000.—*Commonwealth Engineer.*

Barrow.—Reciprocal Supply of Electricity.—At a recent meeting of the Corporation it was decided to accept the offer of Messrs. Vickers, Ltd., for a reciprocal supply of electricity. In order that the supply may be utilised to the best advantage, the following plant is to be purchased:—A 30,000-lb. per hour boiler, with superheater, £6,000; e.h.p. switchgear, £2,550; e.h.p. feeder, £2,000; rotary or motor converter, with switchgear, £4,500; renewal of stokers, £1,800; alteration of boilers and ash-handling arrangements, £1,650; a total of £18,500.

Calne.—Electricity Supply.—The Town Council has engaged Mr. James Perkins to prepare an electric lighting scheme for the district.

Canada.—The Hollinger Gold Mine.—Great activity is reported at the Hollinger gold mine, which will eventually be one of the largest in the world. Many new companies have been formed and so great has been the demand for power that an acute shortage is being experienced. The Great Northern Power Co., has started up a 2,000-h.p. set on the Montreal River, and two similar sets will be completed by July next. At the same time an American company aims at the development of 25,000 h.p. by employing the power of the Abitibi River.

Hydro-Electric Scheme.—A contract for the supply of machinery at a cost of $1,500,000 has been awarded by Mr. J. B. Duke, of Charlotte, and Sir William Price, of the Quebec Development Co., Ltd., to the Canadian Allis-Chambers Co., of Quebec. The machinery will be utilised in the development of 1,000,000 h.p. at a dam on the Saguenay River, in the Province of Quebec.—*Reuter's Trade Service* (Charlotte, N.C.).

Continental.—France.—A scheme has been put forward by M. Beaud, Municipal Councillor, for harnessing the Seine. It has been drawn up by an engineer, M. Chabal, and provides for 23 large reservoirs above Paris, along the Seine and its tributaries. These reservoirs would contain 2,325 million cubic metres of water. Power stations would be erected at the entrances to the reservoirs for the utilisation of the fall of water, and it is estimated that it would be possible to obtain 300,000 h.p. M. Chabal estimates that the whole of the scheme would cost 1,700 million fr., and would take twenty years to execute. M. Beaud, in presenting the plan, suggests that the departments interested should be asked to create an inter-departmental association of the same kind as that which has been created for the purpose of carrying out the harnessing of the Rhône.—*Reuter's Trade Service* (Paris).

Germany.—The Rhine-Main-Danube Canal Co. announces the issue of dollar bonds guaranteed by Prussia and the Republic. The construction programme, which is now complete, covers a period of 20 years, and begins with the stretch Aschaffenburg-Wurzburg. Fifteen new power stations, developing 360,000,000 kW yearly, form part of the scheme.

Darlington.—Power Charge Reduction.—At a meeting of the Electricity and Light Railways Committee on March 23rd, a proposal was adopted that, in order to assist industrial revival in the town, the price of electricity for power should be reduced to the pre-war level.

Dartford.—Electricity Scheme.—The Town Council proposes to obtain a bulk supply of electricity from the Woolwich Corporation for a period of 20 years, and application is to be made to the Electricity Commissioners for sanction to borrow £45,150 for mains. If the Commissioners approve of the linking up of the two districts, the Woolwich Corporation will furnish a bulk supply to Bexley and Erith also, and the power stations, in the three districts will be closed down.

Derby.—No Immediate Reductions.—In reply to a question at the last meeting of the Town Council, Ald. Wilkins stated, on behalf of the Electricity Committee, that there was no likelihood of consideration being given for some months to come to any further reduction of charges for electricity. Reference had been made to the lower rates prevailing in other towns, but he pointed out that at Nottingham, Leicester, Loughborough, Burton, and Chesterfield the cost was 17 per cent. higher than at Derby.

Devizes.—New Plant.—The Wilts. County Council has decided to expend £1,950 upon the installation of new steam engines and generators at the County Asylum.

Edinburgh.—Improved Street Lighting.—The Corporation is improving the public lighting in the town by installing lamps of greater power at a total increased cost per annum of £2,710.

Exeter.—Loan.—The Corporation is applying to the Electricity Commissioners for sanction to the borrowing of £6,500 for new boiler plant for the electricity works.

Falkirk.—Extensions.—The Council has authorised its Electricity Committee to proceed with a scheme of extensions costing £30,722. During a discussion of the proposal it was suggested that it would be cheaper to obtain a bulk supply from the Scottish Central Electric Power Co., but the chairman of the Committee showed that this would involve greater expense in the end, and the proposal was therefore negatived.

Grampians.—Hydro-Electric Scheme.—It is officially stated that Mr. George Balfour has acquired the control of the Grampians hydro-electric scheme for his associated interests.

Huddersfield.—Year's Working.—At a recent meeting of the Town Council, the Borough Treasurer submitted a statement upon the working of the Electricity Department for the year ended December 31st, 1922. This showed a revenue of £191,869, as compared with £203,928 in the previous year, and a net surplus of £21,580 (£412). The items of expenditure showed a reduction in most cases; maintenance from £18,030 to £17,452, fuel costs from £89,580 to £56,490, and wages from £17,826 to £15,011. Salaries showed a slight increase, as did also the loan charges.

Japan.—Electricity Supply Industry.—The Japanese Department of Communications reports that at the end of 1922 there were in Japan 842 enterprises for the supply of electricity for various purposes, and their total capital amounted to 2,325,552,000 yen. As compared with the total at the end of the previous year, this shows an increase of 21 enterprises and of 364,143,000 yen in the amount of capital. Their capacity was estimated to be 1,988,226 kW. During the year the Government gave permission for utilising water power at seven places. These new works are expected to develop 8,400 h.p.—*Eastern Engineering.*

London.—St. Pancras.—The Finance Committee reports a balance of profit of £40,487 upon the electricity undertaking for the year now ending. It is recommended that outstanding loans upon obsolete plant, amounting to £5,582, be written off, and that £25,000 be contributed to the relief of the rates.

Maimesbury.—Electricity Supply.—The Town Council has consented to the application of the Western Electric Distributing Corporation for a Special Order to supply electricity within the borough, provided that no overhead cables are used in the town.

Newfoundland.—Water-power.—The Advisory Committee under the Trade Facilities Act has approved a scheme which aims at the development of water-power to produce electricity for pulp and paper mills. A sum of £4,000,000 will be guaranteed jointly by the British and Newfoundland Governments. The site of the proposed developments is Deer Lake, from which, it is estimated, between 230,000 and 240,000 h.p. could be obtained. The promoters aim at developing 100,000 h.p. in the first place, and the plant will be extended as the demand for power grows. The hydraulic work will be carried out by Sir W. G. Armstrong, Whitworth & Co., Ltd., who are "interested" in the scheme. It is proposed to use electric boilers on a very large scale for the production of the steam necessary in the production of pulp and paper.

Newton Abbot.—Arbitration.—The arbitration proceedings regarding the sale of the local undertaking of the Urban Electric Supply Co. to the Council were concluded on March 21st. Mr. Tyldesley Jones, K.C., who appeared for the company, said that the Council's accusations of profittering against the company were untrue; it was the policy of the company to charge as low a price as possible to develop the industry. The figures supplied by the Council to prejudice the company's interests contained a number of serious blunders. The Arbitrator (Mr. Ernest Page, K.C.) said that he would endeavour to issue his award by Thursday of this week.

Northern Ireland.—Holywood (Co. Down).—At a meeting of the Urban Council on March 22nd, it was decided to proceed forthwith with the scheme for the erection of an electricity generating station. The plans have been prepared by Mr. Green, of London, and the estimated cost of the scheme is £8,000, towards which it is hoped to obtain a grant from the Government out of the money allocated for the relief of unemployment.

Oldham.—Loan Sanctioned.—The Town Council has received sanction from the Electricity Commissioners to a loan of £30,000 for mains.

Price Reductions.—The following reductions are being made in charges for electricity:—

Bognor.—Lighting, from 9d. to 8d. per kWh; power and heating from 3d. to 2½d. per kWh.

Brighton.—Lighting, flat rate, from 5½d. to 5d. per kWh; sliding scale charges; first 10,000 kWh per annum from 6d. to 5d. per kWh; next 10,000 from 5d. to 4d. per kWh; next 10,000 from 4d. to 3d. per kWh; all energy over 30,000 kWh per annum, from 3d. to 2d. per kWh.

Leigh.—Lighting, the percentage increase on pre-war charges from 60 to 50 per cent.; ordinary power and heating, from 85 to 65 per cent.; large a.c. supplies from 100 to 70 per cent.

Pembroke.—Lighting, from 10d. to 8d. per kWh.

St. Albans.—Lighting, from 9d. to 8d. per kWh; heating, from 3d. to 2½d. per kWh; power, from 50 to 33⅓ per cent. over the pre-war rate.

Wimbledon.—Lighting from 7d. to 6d. per kWh; shop window lighting for advertising purposes from 4d. to 2d. per kWh; cooking and heating, the present charge of 1½d. to be reduced to 1d. per kWh for the summer quarters. This is the second reduction in six months.

Worcester.—Lighting. from 7d. to 6½d. per kWh; heating and cooking, from 1½d. to 1d. per kWh; hospitals and consumers with special contracts from 5d. to 4½d. per kWh; theatres and kinemas, the basic rate to remain unchanged, but the additional charge to be reduced from 60 to 40 per cent.; the same proposal is to apply to electricity for power purposes.

Aldershot.—Lighting from 10d. to 9d. per kWh, the minimum charges to be 11s. 3d. for each winter quarter and 7s. 6d. for each summer quarter.

Sheffield.—Loan Sanctioned.—The Town Council has received the sanction of the Electricity Commissioners to the borrowing of £12,390 for mains.

Southampton.—Dock Supplies.—It is estimated that when the new floating dock is completed, the Southern Railway Co. will have an annual requirement of three million kWh of electricity. The borough electrical engineer (Mr. W. G. Turner) has formulated proposals to supply the company in bulk on advantageous terms. He proposes a charge of 7s. 6d. per month per kW of maximum demand up to 750 kW., and 6s. 8d. per kW after this, plus a "unit" charge of .315d., subject to variation with fluctuations in the price of coal. The Corporation's plant is adequate to meet the demand, and the cost of giving the supply is put at £8,360. The annual revenue, it is estimated, would be £10,000. The new floating dock will be equipped with 14 motor-driven centrifugal pumps, capable of dealing with 80,000 gallons of water in four hours; and electric capstans and cranes. The last will include a 150-ton crane for the handling of heavy machinery.

Surrey.—Electricity Supply.—The South Metropolitan Electric Traction & Lighting Co., Ltd., announces that steps will be taken shortly to give a supply of electricity to Walton-on-the-Hill, Tadworth, and Banstead, and it is hoped that a supply will be available for next winter.

The Wirral Peninsula. — Commissioners' Inquiry.—A scheme for taking over and controlling the generating stations in the Wirral peninsula has been prepared by the Electricity Commissioners. The proposal is to constitute a committee for the district on which Birkenhead will have three representatives, Wallasey three, Bebington and Bromborough one, Hoylake and West Kirby one, and the Wirral Rural Council and the Neston Urban Council one between them. The Commissioners propose holding an inquiry, and May 3rd has been provisionally fixed as the date.

Tiverton.—Electricity Supply.—The Town Council has decided to engage a consulting engineer to prepare a scheme for supplying the town with electricity. The estimated cost of carrying out the work is £15,000.

Wrexham.—Bulk Supply.—Last week a supply of electricity from Gresford Colliery to the town was commenced. For some time past the capacity of the Corporation's plant has been inadequate to meet the demand, which now amounts to one and a half million kWh per annum, and the Gresford scheme is an expedient pending a permanent solution of the problem of supply, which rests between the enlargement of the present station, together with the substitution of more modern plant, and a bulk supply from either Dolgarrog or Chester.

TRAMWAY AND RAILWAY NOTES.

Burton.—Track Renewals.—The Town Council proposes to expend £9,000 on renewals of certain portions of the tramway track.

Continental.—Holland.—The question of the electrification of the railway between Rotterdam and Amsterdam was discussed on March 13th by Mr. J. J. W. Van Loenen-Martinet, chief of the electric traction department of the Netherlands State Railways, before The Hague section of the Netherlands Association of Railway Officials. He stated that on the advice of the Committee of Inquiry it had been decided to adopt the d.c. system, at 1,500 V, although this pressure could be doubled if necessary in the future.

Italy.—The Italian Minister of Public Works has prepared a scheme for handing over certain of the State railways to private enterprise. The electrification of the railways is to be abandoned except on routes with steep gradients.

Edinburgh.—Tramway Sidings.—A sub-committee of the Tramways Committee has recommended the construction of tramway sidings at Morningside Station and Piershill, with a view to keeping the lines clear for cars proceeding to the terminus.

Huddersfield.—Track Renewals.—The Tramways Committee proposes to renew the tramway track in Viaduct Street, and to double a portion of the track in Wakefield Road. Application is to be made to the Unemployment Grants Committee for assistance toward the cost of carrying out the work.

London.—Accident.—On March 20th, an electric train travelling from Watford to Broad Street ran into the rear of a stationary steam train outside Broad Street Station. The motor-car of the electric train was smashed, imprisoning the driver, who was removed to St. Bartholomew's Hospital.

Underground Station Improvements.—Plans are being prepared for the installation of escalators at the following stations:—Clapham Common, Clapham Road, Stockwell, Oval, Moorgate Street, Old Street, Shepherd's Bush, Oxford Circus, Bond Street, Tottenham Court Road, Trafalgar Square, and Elephant and Castle. The cost of carrying out the work is estimated at £800,000.

London County Council.—The agenda for the meeting of the Council on Tuesday last contained the following motion, put down by Mr. Webb:—"That it be referred to the Highways Committee to consider and report whether or not powers should again be sought to construct the tramways approved by the Council on November 4th, 1921; and whether or not powers should also be sought for the Council to own and operate omnibus services in the County of London and the Home Counties."

Middlesbrough.—Position of Undertaking.—A comparative statement was presented to the Middlesbrough Corporation Tramways Committee on March 21st by the manager (Mr. H. G. Jeken). The gross profit for the past year, he said, was £11,708, which equalled 4.24d. per car-mile. Had it not been for the high cost of the Corporation's purchase, the tramways would be a paying concern. The Corporation had had to deal with an accumulation of repairs to the system over seven years owing to the owning company having been notified of the Corporation's intention to acquire the system. Considerable improvements had been effected, and, with a revival in trade and reduction of working costs, it was hoped that revenue would cover interest and sinking fund demands.

Year's Working.—There was a loss of £25,000 on the tramway undertaking of the Corporation during 1921-22.

Stalybridge.—Extension of Time.—Powers are being sought by the Stalybridge, Hyde, Mossley and Dukinfield Joint Tramways Board to extend the time for constructing tramways sanctioned in 1915.

TELEGRAPH & TELEPHONE NOTES.

Guernsey.—State Telephone Service.—The accounts and statistics for the year ended December 31st, 1922, of the State Telephone Department (of which Mr. E. H. Bennett is manager and engineer, and Mr. A. R. Bennett, M.I.E.E., consulting engineer), show that the working expenses amounted to £13,261, the revenue being £13,680, so that the net profit for the year was £418, a decrease of £393 on the previous year's result. The number of subscribers' lines increased by 194 to 2,532, the mileage of overhead circuits by 134 to 2,175¾ miles, and the mileage of underground circuits by 837¾ to 2,278¼ miles. The total number of calls in the year increased by 95,769 to 1,721,363, and the number of letters and telegrams telephoned to the Post Office increased by 846 to 18,163.

International Long-distance Telephony. — Committee's Decision.—The International Committee on Long-distance Telephony concluded its labours at Paris on March 20th. It was unanimously decided, with a view to attaining complete uniformity both in technical theory and practical working, to favour the establishment of a permanent international advisory commission on international telephonic communication on which all the European countries should be represented, and having a permanent secretariat in Paris which would also be an international bureau of technical information. The committee agreed upon the principles which should govern the construction, development, and upkeep of an international telephone system, and drafted a scheme for the development work considered immediately necessary, to be completed in 1923 and 1924. At a subsequent meeting to take place this year the committee will draft an extensive ten years' programme of development. The proceedings were throughout most cordial. —*Reuter* (Paris).

Italy.—Fire.—Early in the morning of March 24th a fire at the head post office in Rome completely destroyed the telegraph apparatus, including the newly-installed Baudot instruments. Only parts of the Hughes and Morse instruments were saved and the damage is estimated to represent at least 5,000,000 lire, says the *Manchester Guardian*.

The Telephone Service.—Night Calls to Holland.—The Postmaster-General has arranged, in conjunction with the Dutch Government, for subscription calls at half rates to be accepted in future between 7 p.m. and 8 a.m. A call of six minutes' duration at a fixed hour can be obtained at the same cost as a day call of three minutes, subject to the caller agreeing to make the call for a period of one month. The ordinary night rate to Holland (three-fifths of the day rate) is also applicable during the extended hours.

Objection to Poles.—At Bow County Court on March 19th, before Judge Snagge, the Postmaster-General sought permis-

sion to erect at Leyton (Essex) 76 telephone poles, affecting 33 roads, objection having been raised to the proposal by the Leyton Urban District Council. Judgment was reserved.

RADIO-TELEGRAPHY AND TELEPHONY.

Australia.—Broadcasting.—Amalgamated Wireless (Australasia), Ltd., has made a move with regard to broadcasting. Details are lacking, but it is believed that a high-power broadcasting station will be erected at a suitable point on the coast in preference to a site in one of the principal cities. Arrangements will be made with newspapers and news agencies to supply the station with news from all parts of the world up till midnight; a selection will then be made and immediately transmitted broadcast.

Both overseas and inter-State steamship companies will be invited to subscribe to the scheme, and only those vessels whose owners are subscribers will be permitted to publish the broadcast news. It is not yet known what method of printing will be adopted aboard vessels, or whether a charge will be made for the paper. Although the scheme will be pushed ahead as quickly as possible, it is not likely to be put into operation until the end of next month.—*Reuter* (Sydney).

Austria.—Marconi Service.—The Austrian Assembly, on March 21st, passed a Bill granting the British Marconi Co. permission to found an Austrian branch company with a capital of £130,000 for the operation of radio services beginning April 1st.—*Financier.*

Broadcasting.—London Station.—The London station of the British Broadcasting Co., known as 2 L O, which is situated at Marconi House, is to be moved when a convenient site has been decided on. The programmes which are broadcast daily have been interfering to some extent with the reception of official signals at the Air Ministry, which is quite near.

Theatre Ban.—With further reference to our last week's note on the above subject, the committee of theatre managers formed under the chairmanship of Mr. J. E. Vedrenne, president of the Society of West End Theatre Managers, to consider broadcasting in relation to the theatre, was to call a conference, intended to be representative of every branch and grade of the entertainment industry, for March 28th, to discuss the matter further.

In the meantime certain singers and instrumentalists who make records for the Gramophone Co. have received an intimation that the terms of their contract debar them legally from taking part in broadcast concerts.

India.—Radio Telegraphy.—In the Legislative Assembly, Sir Sydney Crookshank, Public Works Member, said on March 22nd that the main wireless station of India, for which Agra appeared to be the most convenient centre, would probably be handed over for construction and working by private enterprise, the Government retaining a certain amount of control through the possible possession of shares or by reversion. He added that the cost of the main station would approximate £500,000, and the station would consist of three establishments, one for transmitting and two for receiving, the latter being some forty miles distant from the former.

It would approximately cost £50,000 to run, and the Government was communicating with two Indian firms and the agents of the Marconi Co. With regard to the eight coastal and twelve inland stations already in existence, they would all remain under State control. Arising out of these were the inland feeder stations, which would be operated by the local Governments, and in addition there would be privately-owned stations operating under a licence from the Government. Further, the Indian States, under agreement with the Director-General of Posts and Telegraphs of the Indian States, would be able to operate State-owned or licensed stations. Lastly was the proposed new broadcasting scheme. The Government, he said, was anxious for the setting up of a Rupee Company with Indian directors.—*Reuter* (Delhi).

Malta.—Shipping Rules.—An Ordinance has been passed by the Government of Malta making the installation of radio apparatus compulsory on every British sea-going ship registered in Malta, being a passenger steamer, or ship, of 1,600 tons gross tonnage and upwards, and also on ships other than British ships registered in Malta of similar categories while they are within a port of the Islands of Malta. The Ordinance is entitled "The Merchant Shipping Wireless Telegraphy Ordinance, 1923," and gives the Governor power to make rules prescribing the form of licence to be required, the nature of the installation and service, and the number, grade, and qualifications of operators and watchers to be carried.—*The Times.*

Radio at Sea.—Lightships.—All lightships around the coast of the British Isles are being fitted with radio apparatus, says the *Daily Mail*. The Harwich lightship alongside the quay is now being fitted with apparatus. The first lightship to be fitted was the Mersey Bar ship, which has already been instrumental in summoning assistance quickly to ships in distress.

Control of Ships.—The possibilities of radio control in naval warfare were shown on March 21st at manœuvres of the United States Fleet off the Pacific entrance to the Panama Canal, when the battleship *Iowa* was steered by radio from Shawmut, several thousand yards away, and was at all times under perfect control.—*The Times.*

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Australia.—Melbourne.—April 10th. Commonwealth of Australia. 686 tons bronze wire, 1,899 tons copper wire, 714 tons galvanised wire. (March 23rd.)

Brisbane.—May 11th. Postmaster-General's Department. Cable terminal boxes.*

Sydney.—June 13th. New South Wales Railways. Two 20,000-kW turbo-alternators for the White Bay power house. Chief electrical engineer, 61, Hunter Street, Sydney.—*Reuter's Trade Service* (Melbourne).

Barking.—April 10th. County of London Electric Supply Co., Ltd. Complete piping equipment for the Barking power station, including steam, water, and compressed air piping, water storage tanks, and auxiliary pumps. (March 9th.)

Barnet.—April 4th. Board of Guardians. Rewiring of the workhouse, with repairs to the electrical installation. (March 23rd.)

Belgium.—April 10th. Municipal authorities of Schaerbeek. 8,000 metres of earthenware ducts. Service de l'Electricité, Hotel Communal, Place Colignon, Schaerbeek, Brussels.

Municipal authorities of Fooz (Province of Liége). Establishment of a l.p. electricity distribution system in the town and the supply of electrical energy.

April 24th. The provincial authorities at Kinroy (Province of Limbourg). Establishment of l.p. electricity distribution systems in the villages of Ophoven, Geystingen, Molenbeersel, Kinroy, and Kessemmich.

Cavan.—April 10th. Cavan County Surgical Hospital. Electric lighting installation in the hospital theatre and surgeon's residence. Mr. P. Reilly, registrar, County Home Office, Cavan.

Coventry.—April 19th. Electricity Department. Pipework, two-phase switchboard. (March 16th.)

Edinburgh.—April 16th. Electricity Supply Department. 6,600-V and 33,000-V switchgear, two induction motors, 33,000-volt overhead main transmission line. (See this issue.)

Manchester.—April 7th. City Waterworks Committee. Two 300-kW rotary converters, with static transformers, h.p. and l.p. switchgear, &c. Four electrically-driven centrifugal pumps, 3,000-4,000 gallons per minute, switchgear, pipes, valves, &c. Secretary, Waterworks Offices, Town Hall, Manchester.

Milnrow.—April 9th. Electric lighting installation at Milnrow Wesleyan chapel and school. Mr. Herbert Shepherd, secretary, 35, Simeon Street, Milnrow.

South Africa.—Cape Town.—April 18th. Municipal Council. Air-cooled transformers.*

May 7th. 5,000 25-amp. ironclad service cut-outs.*

Uruguay.—Monte Video.—April 20th. State Electric Light Works. Electric clocks.*

May 1st. H.p. armoured cable, telephone cable, and accessories.*

West Ham.—April 5th. Education Committee. Electrical wiring of 12 schools. (March 16th.)

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

CLOSED.

Australia.—Messrs. Foster Bros., Ltd., of Wednesbury, have secured the contract for the high-pressure pipework for the Morwell power station of the State Electricity Commission of Victoria.

Melbourne.—Victorian Electricity Commission. Accepted: Four water-tube boilers for the Yallourn briquetting works (£71,026).—Babcock & Wilcox, Ltd.—*Reuter's Trade Service* (Melbourne).

Belgium.—Two Belgian and one each French, Dutch, and British (Callender's Cable and Construction Co., Ltd., London) concerns submitted tenders last week to the municipal authorities of Liége for the supply of a quantity of armoured electric cables. The lowest tender was that of the Société des Ateliers de Constructions Electriques, of Charleroi.

Bolton.—Education Committee. Accepted:—
Installing electric light in the following schools, viz.:—Chalfont Street, Clarence Street, and Clarendon Street Council schools.—Mr. Geo. Blackburn.

Cardiff. — Great Western Railway.—Electro-hydraulic pumping plant at Cardiff Docks.—Electric Control, Ltd., has received the contract for four sets of automatic equipment for controlling the motor-driven pumping plant.

Faversham.—Town Council. Accepted:—
Cable for East Street (£400).—W. T. Henley's Telegraph Works Co., Ltd.

Government Contracts.—The following Government contracts were placed during February:—

Admiralty Contracts and Purchase Department.
Electrically-driven air compressor.—Peter Brotherhood, Ltd.; sub-contractors for motor: English Electric Co., Ltd.
Plate groups and separators for batteries.—Chloride Electrical Storage Co., Ltd.
Cables and cable boxes.—W. T. Henley's Telegraph Works Co., Ltd.
Underground cables and switchgear.—Foote Milne & Co.
Cells.—Fuller's United Electric Works, Ltd.; Premier Accumulator Co. (1921), Ltd.; D.P. Battery Co., Ltd.
Condensers.—Telegraph Condenser Co., Ltd.
150-h.p. motor with control gear, &c.—General Electric Co., Ltd.
Platinum wire.—Johnson, Matthey & Co., Ltd.
Pyrometer and CO_2, outfit combined, and accessories.—Cambridge & Paul Instrument Co., Ltd.
Rotary converters, switchgear and cables.—British Thomson-Houston Co., Ltd.

Air Ministry.
Electric Lamps.—Stella Lamp Co., Ltd.
Magnetos.—British Thomson-Houston Co., Ltd.
Supply line.—Johnson & Phillips, Ltd.

Crown Agents for the Colonies.
Insulated cable.—Hooper's Telegraph and I.R. Works, Ltd.
Ducts.—Albion Clay Co., Ltd.
Electric lamps.—General Electric Co., Ltd.
Telephone cable, &c.—W. T. Henley's Telegraph Works Co., Ltd.
Copper wire, &c.—F. Smith & Co.

Post Office.
Manufacture, supply, drawing-in, and jointing cable.—Bolton-Bury-Heywood: W. T. Glover & Co., Ltd. Bristol-Bath: W. T. Henley's Telegraph Works Co., Ltd.
Lifts.—Post Office Savings Bank.—W. Wadsworth & Sons, Ltd.
Telephone exchange equipment, for Babcock & Wilcox, Ltd., for J. & N. Phillips & Co., Ltd., and for Higginson & Co., Ltd.—Relay Automatic Telephone Co., Ltd.
Telephone apparatus.—Automatic Telephone Manufacturing Co., Ltd.: British L. M. Ericsson Manufacturing Co., Ltd.; General Electric Co., Ltd. (Peel-Conner Telephone Works); Phœnix Telephone and Electric Works, Ltd.; Sterling Telephone and Electric Co., Ltd.
Telegraph and telephone cable.—Connollys (Blackley), Ltd.; Enfield Ediswan Cable Works, Ltd.; Pirelli-General Cable Works, Ltd.; Siemens Bros. & Co., Ltd.; Union Cable Co., Ltd.
Casing and cover.—W. Duncan, Tucker & Sons, Ltd.
Joint-box castings.—McDowall, Steven & Co., Ltd.; United Steel Companies, Ltd. (Messrs. Thos. Butlen & Co.'s branch).
Secondary stationary cells.—London Battery and Cable Co., Ltd.
Telephone cords.—British Insulated and Helsby Cables, Ltd.; Siemens Bros. & Co., Ltd.
Ducts.—Albion Clay Co., Ltd.; Hepworth Iron Co., Ltd.; J. Oakes and Co., Ltd.
Telephone earpieces.—North British Rubber Co., Ltd.
Insulators.—T. De la Rue & Co., Ltd.
Stay rods.—Bullers, Ltd.
Bronze wire.—British Insulated and Helsby Cables, Ltd.; Enfield Ediswan Cable Works, Ltd.
H.d. copper wire.—Elliott's Metal Co., Ltd.; R. Johnson & Nephew, Ltd.; Shropshire Iron Co., Ltd.; F. Smith & Co., incorporated with the London Electric Wire Co. and Smiths, Ltd.
G.i. wire.—Rylands Bros., Ltd.

H.M. Stationery Office.
Electric motors.—Electromotors, Ltd.
Motor generator.—J. H. Holmes & Co.

H.M. Office of Works.
Engineering services.—Electric wiring at Science Museum.—Alpha Manufacturing Co. Teddington Laboratory (erection of panels, &c.).—Electric Installations, Ltd.

London.—Stepney.—Electricity Supply Committee.
Half mile .04 4-core armoured cable, and half mile .1 lead-covered single cable (£362).—W. T. Henley's Telegraph Works Co., Ltd. (Recommended.)
Circulating-water piping at Limehouse generating station (£149).—Stanton Ironworks Co., Ltd. (Recommended.)

Cut-outs for house services:—

	1,000 2-core. £	250 3-core. £	100 4-core. £	2,500 15/30-amp. £	1,500 30/50-amp. £
General Electric Co., Ltd.	**404**	**156**	**96**	406	306
W. T. Henley's Telegraph Works Co., Ltd.	437	187	101	**386**	**306**
Reason Manufg. Co., Ltd.	(unable to quote)			458	312

The Committee recommends acceptance of the General Electric Co., Ltd., tender for 2-core, 3-core, and 4-core, and W. T. Henley's Telegraph Works Co., Ltd., for 15/30-amp. and 30/50-amp. cut-outs.

Coal:—
Two barges Newstead 1¼-in. slack, at 24s. 9d. ton.—Charrington, Gardner, Locket & Co., Ltd. Two barges Pleasley 1¼-in. slack, at 24s. 6d. ton.—Bradbury, Son & Co. (1920), Ltd. 500 tons Hawkins Cannock 1¼-in. nutty slack, at 21s. 7d.—E. Foster & Co. (Accepted.)

Cable for 12 months:—

Hackbridge Cable Co., Ltd.	£14,670
W. T. Henley's Telegraph Works Co., Ltd. (recommended)	**16,515**
W. T. Glover & Co., Ltd.	16,842
Siemens Bros. & Co., Ltd.	16,846
Pirelli-General Cable Works, Ltd.	16,862
Western Electric Co., Ltd.	16,898
British Ins. & Helsby Cables, Ltd.	16,951
Callender's Cable & Cons. Co., Ltd.	17,920

Water-screening plant at Limehouse generating station:—

Babcock & Wilcox, Ltd.	(a)	£3,498
(recommended)	(b)	**3,588**
	(c)	3,670
F. W. Brackett & Co., Ltd.		4,490
Buderus Trading Co., Ltd. (does not comply with specification)		2,278

D.C. switchboards at Mile End sub-station:—

	Including instruments of tenderer's own manufacture.	Including "Weston" instruments.
Edison Swan Electric Co., Ltd.	£1,540 (recommended)	**£1,700**
Bertram Thomas	1,840	1,948
Switchgear & Cowans, Ltd.	1,845	1,957
Ferguson, Pailin, Ltd.	1,889	1,902
General Electric Co., Ltd.	1,948	2,063
Johnson & Phillips, Ltd.	1,955	2,075
Park Royal Enging. Works, Ltd.	2,055	2,176
Erskine, Heap & Co., Ltd.	2,102	2,220
Nalder Bros. & Thompson, Ltd.	2,300	2,490
Metropolitan-Vickers Electl. Co., Ltd.	2,550	2,660

Battersea.—Electricity Undertaking Committee.
Rotary converting plant (£7,644).—General Electric Co., Ltd. (recommended).

Italy.—The Società Italiana Ernesto Breda has been successful, in competition, for the supply of 40 electric locomotives and trailers for the Lima city and suburban tramways. The same firm has also been successful against 28 competitors in securing the contract for the supply of 20 big locomotives for Egypt. The unsuccessful tenderers comprised some of the largest locomotive works in the States, Canada, England, France, Germany, and Belgium.

Kirkcaldy.—Town Council. Accepted:—
3,000-kW turbo-alternator (£11,500) and 3,000-kW condensing plant (£4,090).—Fraser & Chalmers.

New Zealand.—Southland Power Board. Accepted:—
Main turbines and valves and exciters.—Boving & Co.
Generators, exciters, and battery-charging sets.—English Electric Co., Ltd. The total amount involved is £20,959, and the prices quoted are half those previously quoted for similar material.

Wellington.—Public Works Department.
Quantity of copper cable for the Lake Coleridge scheme (£41,633).—P. R. Baillie & Co.—*Reuter's Trade Service* (Melbourne).

Newfoundland.—Messrs. Sir W. G. Armstrong Whitworth and Co., Ltd., have the contract in hand for the 100,000-h.p. hydro-electric works, turbines, and other equipment in connection with the Newfoundland (Deer Lake) pulp and paper mills scheme.

Oswaldtwistle.
Installation of electric lighting at St. Paul's church, Oswaldtwistle.—J. Walton & Son, Nelson.

Portsmouth.—Board of Guardians. Accepted:—
Electrical fittings.—Mr. H. A. Evans, Southsea.

Watford.
New power station chimney, &c., Delectaland (£2,500).—W. J. Furze and Co., Ltd.

FORTHCOMING EVENTS.

Liverpool Engineering Society.—Wednesday, April 4th. At the Royal Institution, Colquitt Street. At 8 p.m. Papers on "The Combustion of Fuel," by Prof. G. E. Scholes, and on "Considerations in Design and Application of Surface Heaters," by Mr. B. Stephenson.

Institution of Electrical Engineers (South-Midland Centre).—Wednesday, April 4th. At the University, Birmingham. At 7 p.m. Ordinary meeting. Report on the Permissible Loading of Paper-insulated Cables.

Junior Institution of Engineers.—Friday, April 6th. At the Cannon Street Hotel, E.C. At 6.30 p.m. Annual dance.

Institute of Transport.—Friday, April 6th. At the Institution of Electrical Engineers, Victoria Embankment, W.C. At 5.30 p.m. Paper on "The Influence of Transhipment on Rail-borne and Road Traffic, with Special Reference to the Most Economical Methods of Labour-saving Appliances," by Mr. C. Bentham and Mr. J. Rostern.

Royal Society of Arts.—Friday, April 6th. At John Street, Adelphi, W.C. At 4 p.m. Paper on "Postal and Telegraph Work in India," by Mr. G. R. Clarke, Director-General of Posts and Telegraphs in India.

Edinburgh Electrical Society.—Friday, April 6th. At the Philosophical Institute. At 8 p.m. Apprentices' Night.

THE "ELECTRICAL REVIEW" SERVICE DEPARTMENT.

We have to remind readers that Service Department inquiries should be accompanied by a stamped envelope.

The makers or suppliers of the following devices are asked for:—

Duplex vacuum cleaners.
Famos vacuum cleaners.
Indcol dry batteries.
Fox flashlamp refill battery.

NOTES.

Concert.—The Faraday House Old Students' Association held its annual Smoking Concert at the Hotel Cecil on March 22nd. The attendance broke all previous records, and the musical programme provided was a most excellent one. Mr. P. V. Hunter, C.B.E., M.I.E.E., occupied the chair. The concert followed the third annual dinner of the Faraday House Sports Club.

Ljungström Turbine Locomotive.—The Swedish State Railways have given the Nydquist och Holm engineering works a trial order for one Ljungström turbine condensing locomotive.—*Reuter's Trade Service* (Stockholm).

Appointments Vacant.—Telegraph engineer (£600), for the Government of the Gold Coast; electrical meter mechanic, for the Salford Corporation electricity department; plumber-jointer, for the Epsom Urban District Council electric light department. (See our advertisement pages to-day.)

The Katsu System of Resuscitation.—Mr. John A. Brown recently read a paper on "Resuscitation" before a joint meeting of the Scottish Branch of Colliery Managers and the West of Scotland Branch of the Association of Mining Electrical Engineers. The purpose of the paper was to make known a new (or revived) system of treating persons who had received an electric shock which differed essentially from the methods already widely known and practised—the Schäfer, Labord, and Sylvester methods.

The method originated in Japan, whence it was brought by Captain Leopold McLaglan, whose name had now been applied to it.

The system operated by pressure on certain nerve centres which stimulated the nerves and caused a reaction of the heart. The nerves which were effected were those of the pectoral arch, where the thinness of the tissue and other matter left the nerves to the heart most exposed. The other nerve centres affected were the pneumogastric centre and the auditory nerves to the brain. As the nerves were still alive after the heart's action had ceased due to electric shock, a person was not actually dead until decomposition or putrefaction set in—the time for this to take place depending, of course, on the cause of the stoppage of the heart's action and also on the condition of health of the person involved.

In applying the system, the patient is placed in a sitting position and supported by the right or left knee of the operator. The operator's thumbs are placed at the pectoral arch where the muscles leave the nerves most exposed. Pressure is applied at this point with the fingers resting firmly on the diaphragm of the chest, the pressure being applied with both fingers and thumbs downwards and upwards. This operation is continued for some time, and the effect is to stimulate the nerves of the heart, which causes the diaphragm to slightly expand and contract, thereby making the subject inhale and exhale. The action is assisted by giving the patient a blow on the seventh dorsal vertebra with the knee; this tends to stimulate the pneumogastric centres. Alternatively, the nerves of the spine could be stimulated by a blow upon the third from the last dorsal vertebra.

The speaker said that there seemed to be no doubt that the McLaglan system of resuscitation showed marked advantage over the Sylvester, Schäfer, and Labord systems because it was applied to the life-giving centres of the human body rather than to the muscles and arms only.

The s.s. "Belgenland."—The Red Star liner *Belgenland*, which left Belfast last week for her maiden passenger voyage between Antwerp and New York, has a very fine electrical installation, consisting of four 300-kW direct-driven generating sets and one 75-kW emergency dynamo, situated well above the water-line.

Exceptionally good ventilation has been arranged throughout, there being over 300 fans installed in the passenger and crew accommodation, and suitable arrangements are made for supplying hot and cold air, when required, from them. Electric heaters are also fitted in each cabin. The radio apparatus can, if necessary, be worked quite satisfactorily from the main dynamos.

The electrically-driven appliances include no less than six passenger and service lifts, boat-lowering gear, turbine-turning and lifting gear. The bilge pumps, which are also electrically driven, can be operated from the main or emergency dynamo, and a large proportion of the cooking is done electrically, the two large roasters taking 50 h.p. The electric motors alone on this vessel have a h.p. of nearly 1,000, quite apart from the cooking, heating and lighting.

The bell system calls for special comment. In each stateroom there are installed several neat little fittings having two push buttons, one coloured red and lettered "Steward," and the other coloured green and lettered "Stewardess." The buttons light up a small red lamp on the indicator, in addition to which a pilot lamp lights up in the alleyway, to show that a call has been sent. The steward, before entering the room, replaces a push just outside the stateroom door which extinguishes the light indicator, as also the pilot lights in the passages. In addition there is a tell-tale indicator in a central position on board which enables those in authority to check at once any delay which may occur in answering a call.

The Western Electric Public Address System.—A feature of interest at the *Daily Mail* Ideal Home Exhibition was the amplifying and distributing of the band music throughout the exhibition. In this system the control panels and electrical devices distribute the sound telephonically to projectors placed in various positions. The complete equipment is under the control of an operator and the degree of loudness from any one particular projector can be adjusted according to circumstances. To enable this to be accomplished to the best advantage a system of telephones is arranged whereby a person listening in a remote corner can communicate with the operator and arrange for the apparatus to be adjusted as desired. The system has been primarily designed to aid public speakers.

The Western Electric "Public Address System" consists essentially of three distinct portions: the microphone which picks up the music rendered by the orchestra, the amplifier, and the "loud-speaking" projectors. The microphone is mounted on a small bracket in front of the orchestra, and is designed so that the natural period of vibration of the diaphragm is well above speech and music frequencies, so that resonance of the diaphragm at these frequencies is claimed to be avoided. The diaphragm actuates two microphone buttons connected in a special way in the input circuit, so as to eliminate any distortion of the speech or music currents generated in the buttons by the vibration of the diaphragm. The microphone is sensitive to speech at distances of from three to eight feet from it. Owing to the fact that music and singing is generally louder than speech, the microphone may be placed further away from the source of sound.

The amplifier consists of four stages of amplification, the first two being voltage amplification; the third, current amplification, and the final stage power amplification. The power valves in the final stage are connected in a special differential circuit to minimise distortion. The amplifier is constructed in panels, the cabling from the microphones being brought on to one panel, which is provided with means of switching to any desired microphone. It also contains telephone apparatus to enable the operator of the amplifier to get into touch with his observers.

Another panel contains the apparatus associated with the first three stages of amplification, that is, two stages of voltage amplification and a stage of current amplification as explained above. It is on this panel that the total output from the system is regulated by means of a potentiometer situated between the first and second stages. An additional panel contains the necessary measuring instruments, and is provided with plugs and cords so that the current in any part of the system may be measured by plugging into jacks provided on the amplifier panel for this purpose.

The volume indicator is a valve detector device which measures the alternating current power in the system by means of a galvanometer and enables the proper transmission level of the system to be maintained. Finally, a control panel provides for adjusting the volume in the individual projectors. This also contains keys for cutting in or out of the circuit any desired projector and a master key for switching out all projectors simultaneously. Ten projectors served the entire exhibition, operating upon the principle adopted by the Western Electric Co., Ltd. for its radio telephone "loud speaking" equipment. They are of the balanced-armature type.

The system can be used to enable an audience to hear either speech or music from some distant station by introducing a telephone line, or the speaker may face his audience with the microphone in position some few feet in front of him. Although great amplification can be secured it is usually not desirable, as it appears unnatural because the ear is not accustomed to so large a volume of sound. For instance, the buzzing of a mosquito, if magnified to the loudness of a large steam hooter, would probably not be in the least suggestive of the familiar insect.

A Novel Heating Display.—The *National Electragist* (New York) for February, reports a novel scheme adopted by a New York electrical company to impress the public with the nature of electric heating. An enormous bowl fire 4½ ft. in diameter was constructed and mounted on a truck, together with 132 350-Ah cells, weighing 4½ tons. As this proceeded through the streets it projected a "beam" of heat which could be felt at a distance of 30 ft. or more. The bowl was, of course, kept moving—otherwise the public in the immediate vicinity of the truck might have received an unfavourable impression. The company announced that its sales of electric fires had received a considerable impetus as a result of the display.

New Electric Plough Tractor.—At a conference held by the Svenska Motokulturfoereningen a report was read on a new method of constructing tractors with an electric three-phase motor in place of an "explosion motor." The trials have proved very satisfactory, and it is said that the cost of ploughing is considerably reduced by the new machine. The manufacturers are the Aktiebolaget Juneplogen of Bankeryd, in co-operation with the Allmaenna Svenska Elektriska Aktiebolaget. It is stated that motor ploughs and tractors of various constructions are now being used in Sweden.—*Reuter's Trade Service* (Stockholm).

Fatality.—An inquiry was held on March 20th at Jarrow-on-Tyne into an accident which occurred on March 11th at Palmer's works, resulting in the death of an apprentice electrician, William Boyd Watson. A witness stated that Watson and he were overhauling and connecting up a switch at the gas-power station. While Watson was pulling himself up to the cubicle, apparently to look at the connections, having his hands on the floor of the isolating chamber, and one knee on a switch below, a flash occurred and Watson fell with his clothing in flames. The voltage was 6,000. The chief electrician, Mr G. A. Roberts, said an "isolator" had been used. Watson had been warned about touching switches.

A verdict was returned that death was due to shock following burns accidentally received.

Summer Time.—It is officially stated that summer time, which is now fixed by the Summer Time Act, 1922, will begin this year at two o'clock, Greenwich mean time, on the morning of Sunday, April 22nd, and will continue until two o'clock, Greenwich mean time, on the morning of Sunday, September 16th.

The Belgian Cabinet has decided that summer time shall begin in Belgium on March 31st.

The French Chamber has shelved the proposal of the Minister of Public Works to have summer time in France this year.

Radio Broadcasting Notes.—A thrilling instance of assistance given to a disabled vessel in mid-ocean is reported by the Furness liner *Sachem*. After a strenuous battle with Atlantic storms during a tow of 750 miles, this vessel has brought the Norwegian steamer *Capto* safely to harbour at St. Johns, Newfoundland. The *Capto's* distress call was picked up by the *Sachem* when the vessels were about 100 miles apart, but the latter could not locate the disabled ship. The Canadian Pacific liner *Montclare*, equipped with Marconi direction-finding apparatus, plotted the exact positions of the two ships from the signals they were sending out, and communicated the information to the *Sachem*, which then soon came up with the *Capto*. There have been numerous instances during the last few years of vessels in distress miscalculating their position by dead-reckoning and only being saved from complete disaster by the assistance given by other vessels which have been able to take bearings with Marconi direction finders, but on this occasion the value of radio telegraphy was demonstrated in more than one way. By its means the call for assistance was sent out, the correct position of the disabled vessel was determined, it was a means of constant communication between the two ships, and ice reports and warnings from ship and land stations enabled dangerous ice-fields to be avoided. It was also of valuable assistance to both vessels while navigating the dangerous waters around the Virgin Rocks off the Newfoundland coast, advantage being taken of the bearings given at regular intervals by the Canadian shore direction-finding station at Cape Race.

We are informed by the Sterling Telephone & Electric Co., Ltd. (the sole licensee and manufacturer in Europe of these well-known devices), that the Capitol Kinema, Cardiff, has been equipped exclusively with Magnavox loud speakers. This kinema is said to be the largest in Great Britain, having a seating capacity of over 3,000, and radio concerts can be heard in every seat.

The first vessel to benefit by the first "wireless lighthouse" established by Marconi's Wireless Telegraph Co., Ltd., on Inchkeith Island, in the Firth of Forth, is the s.s. *Royal Scot*, owned by the London and Edinburgh Shipping Co., Ltd., which is employed on the London and Leith service, and has been fitted with a special beam receiver to enable the navigating officer to pick his way through the dangerous channels of the Firth of Forth in the thickest fog. The ship's officers were easily able to use the apparatus, which is extremely simple. Only one handle has to be operated; this switches the gear into use, and is also calibrated to give a very fair indication of the distance from the shore in addition to the actual bearing. A conspicuous feature of the transmitting station is a metal framework tower, some 30 ft. high, supporting four metal arms that in turn support a series of vertical wires. The whole revolves on a circular base, driven by an electric motor. The frame is, in effect, an electric reflector, and the waves are projected so as to sweep round the surrounding sea, giving a distinctive signal at each point of the compass.

Electrical Hay Curing in Germany and Austria.—Although a great many farms and estates in Germany and Austria take current from the large overland electric supply stations, the consumption is still very small—reaching, in farms of over 1,000 acres, a value of only about 4 to 5¼ kWh per annum per acre of ploughed land. Of this, about 0.6 to 1 kWh is used for lighting, 1 to 1½ kWh for small motors (chaff-cutters, pumps, &c.), and about 2½ to 3 kWh for thrashing. Recently, however, the electrical curing of hay crops has been developed by Messrs. Siemens, the process consisting in passing a current through the vegetable mass and thus raising its temperature to about 50 deg. C., which is sufficient to kill the plant cells and most of the bacteria present. The green crop is placed in large containers built up of reinforced artificial stone of an insulating nature both as regards electricity and heat. The walls are varnished on the inside to prevent current leakage. The capacity of a container varies greatly—some being as small as 5 cubic yards and others as large as 175 cubic yards. A number of containers are usually built up side by side in some existing outhouse. The floor electrode of the container is formed of galvanised sheet iron or of a grid of iron rods. The crop is spread out uniformly and trodden down, and is then covered by a metal-built lid acting as the second electrode. The various lids are electrically connected together by means of plugs and sockets, and the main switch at the switchboard is then closed. Alternating current at 220 to 500 volts is employed—the higher the voltage the shorter the time taken for the curing process. Neither the current nor the voltage requires any regulation during the treatment. Investigation has shown that as soon as the current is applied, a sort of paralysis or suspension of organic life takes place in the mass of material, and it is due to this fact that no deleterious effects are set up tending to lessen the food value of the product. It is especially advantageous as regards the albumen content, as it is just when the crop is first brought in that it is liable to suffer most in this respect.

Besides this bactericidal effect, the current at the same time heats up the mass of vegetation, and this heating is especially pronounced at first, because the fresh material has a comparatively high resistance, whilst the resistance, when fully treated, is quite low. As it happens, this change of resistance occurs at or about the temperature of 50 deg. C., which, as stated above, is also the temperature of sterilisation. At this temperature the plant cells and bacteria collapse, and the whole mass sinters together, and most of the internal air spaces disappear, thus giving the best conditions for the permanent maintenance of quality. After this, very little further heat is generated because of the low resistance of the stuff, and in this way the process is practically self-regulating. As soon as the whole mass is found to have reached the 50 deg. C. temperature, the current can be switched off. The initial deadening effect of the current continues effective for one or two days, so that it is possible to switch off at any time for a period and to proceed with the process again later on.

Experiment has shown that only about 23 kWh are required per ton of green material treated. Before the actual curing process can be commenced, the crop must be subjected to a preliminary treatment to give it the necessary conductivity. Freshly-reaped, undamaged crops offer a very high resistance to the passage of a current owing to the protective covering of hairs, waxes, gums, &c., on the outer surface. For instance, a mass of such material 20 in. thick required the application of nearly 8,000 volts before any appreciable current would pass. It is the inner, juicy portions of the plant which conduct well, and the best and simplest way of exposing these parts to the action of the current is found to be by chopping up the material. This chopping is in any case desirable in material intended for cattle food, and it also greatly facilitates the handling throughout. After treatment, the hay is left carefully covered up in the containers until wanted for use.

At the present time 24 of these hay-curing installations, with a total capacity of about 9,000 cubic yards, are in operation in Germany, and a further 32 are in course of construction.

The chief advantages claimed for the process are:—

(1) The whole hay crop becomes independent of weather conditions.

(2) The crop can be treated at almost any stage of ripeness, and is not liable to damage through rain, dew, or frost. Also such very juicy materials as turnip leaves, turnip tops, and coarsely-chopped turnips, potatoes, carrots, &c., can be stored indefinitely without deterioration after the treatment.

(3) Independence of weather conditions allows more crops to be raised from a given area. The crops can be cut when in their most nourishing stage (just before flowering).

(4) The retention of the protein in the hay makes clover and leguminous crops serve as real sources of albumen throughout the winter, and it has been found in practice that very satisfactory milk returns have been obtained by the use of the process. The cured crop has been found very suitable for horses, sheep, goats, and fowls—in fact, all animals like it because of its aromatic taste.

(5) The process enables better use to be made of the available labour on the farm, and so leads to economies which more than cover the cost of the electricity.

(6) The load is a desirable one from the power-station point of view, because it is, to a large extent, an all-night load—the work of transporting the crops and loading the containers being done in the daytime, and the current being allowed to do its part at night.—*Elektrotechnik und Maschinenbau.*

An Einstein Rumour.—It is reported from Vienna that Prof. Einstein has made an important discovery in connection with gravitation and terrestrial magnetism—the result of an investigation of the properties of amber.

New Method of Testing Cables.—The usual methods of testing alternating-current high-voltage paper-insulated cables are based upon the ability of the insulating material to withstand excessive potentials in order to determine its condition. Accordingly, these methods are not suitable for routine tests imposed for the purpose of determining the degree of deterioration existing in any particular cable. In the March, 1923, issue of the American I.E.E. journal, Messrs. H. S. Phelps and E. D. Tanzer, both of the Philadelphia Electric Co., describe how, in an effort to develop a routine test which will serve to detect an impending fault, use has been made of the kenotron as the source of high-potential direct current. By means of it a large volume of data has been secured concerning the input-current for a cable as a function of time after complete electrification at a constant high potential which, when plotted as curves, show by their shape the condition of the cable insulation. Curves showing a sharp decrease in the magnitude of input current during the first minute and a gradual but persistent rate of decay for the succeeding six or seven minutes indicate that the insulation is in an acceptable condition from the operating point of view.

Curves showing little, if any, decrease or a persistent tendency to increase during the time interval of the test indicate that the insulation has deteriorated to such a point that the cable may be expected to fail at an early date if retained in service. The degree of deterioration is indicated first: by the time which has elapsed since complete electrification before

the increase occurs, and secondly, by the sharpness of the upward trend of the curve in any instance. The value of this method of testing has been demonstrated by its actually having detected a considerable number of impending cable faults before they became a menace in operation. Additional refinements in the methods of measuring the input current for different classes of cables may be desirable, and further investigations are being carried on.

German Foreign Trade in 1922.—According to the official statistics, the imports of electrical machinery in 1922 amounted to 2,000 tons, as compared with 2,200 tons in 1913. On the other hand, the quantity of the exports of similar machines was 23,700 tons, this contrasting with 41,900 tons in 1913.

Medical Testimony.—One result of the recent electrical exhibition at Leicester is a suggestion by Dr. Millard, the Medical Officer of Health, that, as the advantages of electricity in hygienic and other respects are so great, in future no gas should be laid on to any working-class house that may be erected, emphasising this consideration by reference to the many deleterious results to health occasioned by leakages of gas in houses in the poorer quarters of the city.

Safety in Mines.—The Mines Department has recently published three reports by the Chief Inspector of Mines on the explosions which occurred, in 1922, at Whitehaven, Bannockburn, and Workington. Each of these was caused by shot-firing, and in his recommendations the Chief Inspector says that shot-firing should not be resorted to in fiery mines until all other methods have been exhausted; more care must be exercised in testing for the presence of fire-damp; and the coal-dust in proximity to shot holes must be treated with stone dust or water.

An Engineer's Salary.—At a meeting of the Worksop Urban District Council on March 23rd, a report from the General Purposes Committee was considered. Among other things it recommended that an honorarium of £250 be granted to the electrical engineer (Mr. J. P. Crowther) for his services in connection with recent extensions. Another resolution seeking to fix Mr. Crowther's salary in accordance with the scale laid down by the Incorporated Municipal Electrical Association [*sic.*—presumably the Associated Municipal Electrical Engineers is meant] was abandoned in favour of an amendment postponing the matter until after the whole question of wages and salaries of employés had been settled. In full Council, Mr. Tollerton moved the deletion of the whole of the minutes dealing with these two matters, saying that the ratepayers were already paying their officials as much as they could afford. In accordance with a suggestion, a letter written by Mr. Crowther before his demobilisation in 1919 was read. This letter thanked the Council for its offer to reinstate Mr. Crowther as electrical engineer, but suggested that the salary proposed was inadequate. He asked for £450, including a bonus, and was granted £315 per annum. Mr. Crowther's present salary was £572 10s., said a Mr. White, and he had been treated very generously. He (Mr. White) objected to the payment of the proposed honorarium. Mr. Hartland, defending the grant, implied that the previous speakers' remarks were in bad taste. Mr. Crowther's overtime had averaged 20 hours weekly, and the £250 would work out at 1s. 7d. per hour—a figure received by many less-skilled workmen. Mr. Meadows said that the services of a consulting engineer would have cost £1,500. The proposal to delete the minutes was, however, carried by ten votes to six.

In a subsequent discussion upon another matter connected with the electricity department, Mr. Hartland accused Mr. White of a desire to make that department look ridiculous, and said that he had received a letter from Mr. Crowther tendering his resignation on account of the indignities to which he had been subjected. The letter was referred to committee.

Modernising a Textile Mill.—Alterations in the method of driving one part of the sheds of Messrs. Benson, Turner & Son, Ltd., of Bradford, were necessary through the age and inefficiency of the steam engine which was in use, as apart from the main mill engine; as the boilers were up-to-date and were fitted with mechanical stokers and coal conveyors, with modern economisers, it was decided to put new Corliss cylinders on the engine, increasing the power of this from 600 to 850 h.p., and to make use of the extra power to drive an alternator of 180 kW, which with a four-panel switchboard was fixed in a room at the side of the engine house. The mains were run across the mill yard to a distribution box in the shed, and 25-b.h.p. motors were fixed to drive the shed shafts, the old engine being removed. Lighting for parts of the mill was also taken from the generator. The whole of the work was carried out without any stoppage of the work in the factory. The alterations have given every satisfaction, and have already resulted in considerable reduction in costs of running. The complete rearrangement of the power plant was carried out under the supervision of Mr. J. W. Longley, M.I.Mech.E., consulting engineer.

The Phonofilm.—According to the New York correspondent of the *Daily Chronicle*, Mr. Lee De Forest has invented an instrument, to which he has given the above name, by means of which it is claimed to be possible to synchronise perfectly voice and action on a kinema film of the standard type.

The Conjoint Board of Scientific Societies.—At a meeting held in the rooms of the Royal Society last week, the Conjoint Board of Scientific Societies was dissolved.

A New Wind Turbine.—An ingenious wind turbine, said to be capable of utilising air currents for the generation of power with far greater efficiency than its predecessor—the windmill—has been perfected by Mr. A. Ozaki, a Japanese inventor. He claims that the turbine when in operation turns into power 50 per cent. of the force of the air currents striking the planes. The ordinary windmill utilises but 20 per cent. The equipment includes a storage-battery arrangement by which the power generated may be held in reserve to secure uninterrupted service when the wind subsides.—*Reuter* (Tokio).

Long-distance Radio-Telephony.—It is announced that a committee has been appointed by the Postmaster-General to consider the possibility of developing a transatlantic radio-telephony service on a commercial basis. The *personnel* of the committee is as follows:—Admiral of the Fleet Sir Henry Jackson (chairman), Major-General Sir F. H. Sykes, M.P., Mr. R. A. Dalzell (Director of Telegraphs and Telephones, G.P.O.), Dr. W. H. Eccles, F.R.S., Mr. F. Gill (President, I.E.E.), Mr. E. H. Shaughnessy (Engineer-in-Chief's Department, G.P.O.), and Major A. G. Lee (Engineer-in-Chief's Department, G.P.O.), who will act as secretary to the committee.

Smoke Abatement.—On Friday last, Lord Onslow, Parliamentary Secretary of the Ministry of Health, received a deputation from the Federation of British Industries, on the subject of smoke abatement legislation. Prof. Bone explained the danger to industry involved by ill-considered legislation, and stated that the Federation suggested the desirability of thorough investigation of the matter before further steps were taken.

INSTITUTION NOTES.

Institution of Electrical Engineers.—Informal Meetings.—At the meeting of the Informal Section on March 19th, Mr. W. E. Warrilow was in the chair, when a discussion was opened by Mr. W. S. Caine and Mr. H. T. Young on "The Need for Co-operation Between Manufacturer and Retailer." Mr. Caine began by outlining the systems of distribution from works to consumer, and criticised the alternative methods of mail orders, branches, and agents, and of the ordinary channels with factors and retailers. He did not claim that the last method was flawless, but thought that it was best for the industry to-day, and he appealed for the fullest support from the retailer upon the general principles of team work and co-operation, purchases on a stock basis, preference for British-made goods, and a reasonable profit, as otherwise sales would be restricted.

Mr. Young believed it to be the duty of the manufacturer to supply the user by the most economical method, and that the contractor-retailer was the correct channel to ensure this. He was able to give instances of many flaws in the present system of distribution.

Fifteen speakers took part in the discussion, including the president (Mr. F. Gill).

East-Midland Sub-Centre.—An interesting informal paper on "Automatic Telephones" was read at the Technical College, Derby, on March 13th before the East-Midland Sub-Centre of the Institution. The paper was ably illustrated by an exceedingly effective model and a number of lantern slides. Mr. E. A. Laidlaw stated that there were at least three very good reasons for the introduction of the automatic telephone. It was, financially, a good investment; although the plant required was considerably more expensive than that in a manual exchange, and the charges for interest and depreciation were therefore correspondingly heavier, those considerations were more than balanced by the saving in operating labour. In an average-sized manual exchange, when all administrative charges for operating were included, the average cost for operating amounted to as much as £2 per line per annum. In order to save £2 per annum one could afford to make a capital outlay of £20—usually considerably more than enough to cover the additional cost per line of the automatic equipment. In small country districts only at the busiest time of the day was there really enough work for a full-time operator, yet the service had to be maintained day and night, including Sunday. The system was popular with the public. Telephone systems were rapidly becoming so complex that the training and employment of manual operators in sufficient numbers was becoming a difficult problem, especially in cosmopolitan cities (for instance, in Cairo telephone operators were required to speak, English, Arabic, French, Greek, and Italian). Practically all nationalities could recognise the figures on a dial.

Royal Institution.—On Thursday afternoons, commencing April 12th, Dr. A. O. Rankine will give two lectures on "Transmission of Speech by Light"; Prof. MacGregor-Morris, three on "Modern Electric Lamps"; and Dr. E. G. Coker, two on "Engineering Problems solved by Photo-elastic Methods." The Friday evening meetings will be resumed on April 13th, when the discourse will be delivered by Dr. W. H. Eccles, on "Studies from a Wireless Laboratory." Succeeding discourses will probably be given by Prof. Soddy, Prof. W. A. Bone, Mr. W. M. Mordey, and Prof. Lorentz.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Mr. W. S. Crofts, who has been acting as resident engineer of the National Electric Construction Co. for the past two years, has been appointed engineer and manager to Bo'ness Town Council, which is about to take over the works. Mr. Crofts was previously assistant at Hawick. There were 70 applicants for the position.

Mr. J. Malone, who for some time past has been controller of wireless telegraphy, has been appointed chief telegraphic manager of the Australian Commonwealth P.M.G.'s department. Among his new duties will be investigation of telegraph activities with a view to improving the service, recommendations of additional services, and technical supervision of the programme of new works upon which Parliament last year authorised an expenditure of about £9,000,000. This programme involves several years' work in the provision of arrears of work and additional facilities. Mr. Malone, who has been in the Commonwealth public service for 20 years, made an extensive investigation of wireless, subsequent to the war, in Europe and America.—*Commonwealth Engineer.*

Mr. Colin Milton, of Loughborough, has been appointed borough electrical engineer at Gillingham, Kent. There were 117 applicants for the position.

Obituary.—Mr. T. Campbell.—The death took place on March 17th, at the age of 62 years, of Mr. Thomas Campbell, who was in business with his son as an electrician, in Hall Street, Southport.

Mr. J. F. Coote.—We regret to note from *The Times* "Deaths" columns that Mr. John Frederic Coote, late Executive Engineer, Engineer-in-Chief's Department, G.P.O., London, passed away on March 19th, aged 54 years.

Mr. Gilbert North.—We regret to record the death from pneumonia on March 5th of Mr. Gilbert North, of the Metropolitan-Vickers Electrical Co., Ltd. He was a very old servant of the company, having joined the British Westinghouse Electric & Manufacturing Co., Ltd., in 1903. He left them in 1913 and became managing director of the Dickenson Engineering Co. His strenuous work with this firm through the years of the war, when labour conditions were so difficult, undermined his health, and he was far from well when he rejoined his old firm in November last. Mr. North was an expert in meter design, and many features of the present day a.c. meter were originated by him. He is described as a great moral character who made a marked impression on those with whom he came in contact.

Mr. S. Whitworth.—The *Commonwealth Engineer* reports that Mr. S. Whitworth, of Glen Innes, N.S.W., died suddenly in January. He was at the time engaged in the supervision of the erection of new electrical plant at the Kalgoorlie (W.A.) municipal lighting station, on behalf of the British General Electric Co.

Mr. W. H. Willcox.—We note with regret that Mr. Walter Henry Willcox, governing director of W. H. Willcox & Co., Ltd., passed away on March 26th at Cavendish House, Brockley, S.E. 4.

Sir James Dewar, F.R.S.—We regret to record the death of Sir James Dewar, the celebrated scientist, which occurred on Tuesday after a week's illness. Sir James, who was 81 years of age, passed away at the Royal Institution in Albemarle Street, W., the scene of so many of his achievements. In 1921 Sir James and Lady Dewar were presented with a gold loving cup on their golden wedding by members of that Institution.

It was our sad duty to record the death of Mr. Sidney Sharp, M.I.E.E., which occurred at Ealing on March 1st (Elec. Rev., March 9th, p. 384). We regret to learn that his widow, Ellen Blanche, passed away, also at Ealing, on March 28th.

NEW COMPANIES REGISTERED.

Kelly & Tarshis, Ltd. (188,433).—Private company. Registered March 12th. Capital, £1,000 in £1 shares. To adopt an agreement with T. Kelly and N. Tarshis for the acquisition of the business carried on by them in London as "Kelly and Tarshis," together with the leasehold messuages referred to therein, and to carry on the business of electrical engineers, &c. The permanent directors are:—N. Tarshis, 75, Graham Road, Dalston, E.8; T. Kelly, 13-14, Broadway, Deptford, S.E. Registered office: 5, High Street, Shoreditch, E.C.2.

Rhayader Electric Light and Power Co., Ltd. (188,604).—Private company. Registered March 19th. Capital, £2,000 in £5 shares. To carry on at Rhayader and elsewhere in Radnorshire the business of an electric light company in all its branches. The subscribers are:—O. J. K. Owens, Greenfields, Rhayader, gentleman, 20 shares; J. Shufflebotham, Lion Royal Hotel, Rhayader, hotel proprietor, 10 shares. The subscribers are to appoint the first directors. Secretary: E. D. Prothero. Registered office: Midland Bank Chambers, Rhayader.

Welco Patents, Ltd. (188,612).—Private company. Registered March 19th. Capital, £1,000 in £1 shares. To acquire the business of manufacturers of slotted steel for fixing frames, constructional and other purposes, and electrical engineers and electrical appliance makers, carried on by Welco Patents, at 150, Alma Street, Birmingham. The first directors are:—A. J. Croft, 120, Trinity Road, Handsworth, Birmingham; E. A. Welch, 33, Barker Street, Lozells, Birmingham. Qualification: £1. Secretary: A. J. Croft. Registered office: 150, Alma Street, Birmingham.

British General Radio Co., Ltd. (188,539).—Private company. Registered March 16th. Capital, £3,000 in 4,000 ordinary shares of 5s. each and 2,000 preference shares of £1 each. To take over the business of a wireless apparatus manufacturer, carried on by G. D. Hinks at Hardington, Yeovil, as the G. D. Hinks Wireless Department, together with the selling and manufacturing rights of various wireless components. The first directors are:—G. D. Hinks (life managing director), Bridge Close Farm, Hardington, Mandeville, Yeovil, Somerset; Florence S. M. Hinks, Bridge Close Farm, Hardington, Mandeville, Yeovil, Somerset. Remuneration of managing director, £250. Registered office: 74, Hendford, Yeovil, Somerset.

Universal Publicity Co., Ltd. (12,606).—Private company. Registered in Edinburgh March 16th. Capital, £5,000 in £1 shares. To acquire from H. J. Bernthal and J. MacArthur, junr., their entire interest in certain inventions relating to changeable signs for advertising purposes, and their interest as partners in the firm of J. MacArthur Junr., & Co., and to carry on the business of publicity experts, &c. The first directors are:—H. J. Bernthal, 2, Hamilton Drive, Hillhead, Glasgow, merchant; J. MacArthur, jun., Beachill Tarbert, Argyllshire, merchant; W. J. Radley, 230, West Regent Street, Glasgow, advertising agent; H. E. Gosling, 1, Royal Exchange Court, Glasgow, advertising agent. Qualification: £200 shares.

F. S. Petrol-Electric Omnibus Co., Ltd. (188,591).—Registered as a private company on March 19th, with a nominal capital of £15,000 in £1 shares. The objects are: To carry on in London and elsewhere the business of runners of omnibuses of all kinds, carriers of passengers and goods, manufacturers and repairers of motor omnibuses, coaches and vehicles, &c. The first directors are:—P. Frost Smith, 165, Croxted Road, Dulwich, S.E. (chairman) (representing the holders of shares No. 1-6,000, known as "A" shares); J. M. Mitchell, 2, Wilton Mansions, Kelvinside, Glasgow (representing the holders of shares No. 6,001-12,000, known as "B" shares). Qualification: 250 shares. Remuneration: £12 each per annum. Secretary: P. E. Martin. Registered office: 64, Victoria Street, S.W.1.

Vauxhall Electrical Manufacturing Co., Ltd. (188,633).—Private company. Registered March 20th. Capital, £2,000 in 5s. shares. To carry on the business of manufacturers of, agents for, and dealers in electrical, wireless, broadcasting, telephonic and telegraphic apparatus, &c. The permanent directors are:—H. Rothwell, 13, Canning Place, Palace Gate, Kensington, W., electrical engineer; Capt. G. C. Henry, M.B.E., 33, Beverstone Road, Thornton Heath, Surrey, wireless engineer; T. J. Marchant, 134, The Broadway, West Hendon, N.W., engineer. Qualification: £10. Remuneration as fixed by the company. Secretary: G. C. Henry. Registered office: 28, Albert Embankment, S.E.11.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Smith & Mortimer, Ltd.—J. P. Emett, of 34, Carnarvon Road, Redland, Bristol, was appointed receiver and manager on March 13th, 1923, under powers contained in debentures dated March 31st, 1919.

Snowdon Mountain Tramroad and Hotels Co., Ltd.—Satisfaction in full on March 3rd, 1923 of debentures dated July 10th, 1895, but shown in the return under S12, as dated February 16th, 1898, securing £300.

T. W. Broadbent, Ltd.—Mortgage on land with Victoria Electrical Works erected thereon, dated March 13th, 1923, to secure all moneys due or to become due from the company to Equitable Bank, Ltd., Huddersfield.

CITY NOTES.

Charing Cross, West End, and City Electricity Supply Co., Ltd.

Mr. W. F. Fladgate, M.V.O., presiding at the annual meeting, on March 8th, said that the West End undertaking had not only earned an increased revenue, but on the other hand the production costs had fallen by £25,000, in spite of the larger output. With the amount carried forward, the West End reserves amounted to over £400,000. The revenue of the City undertaking was slightly lower than in the previous year; this was due to the reduced charges made to the West End undertaking for bulk supplies of electricity. The production costs showed a decrease of more than £80,000, although the output increased by 3,000,000 kWh, and £50,000 was spent on repairs to plant and mains.

During the last three years, the capital expenditure had amounted to £560,000. The complete re-modelling of the Bow station had become a necessity, and the work which was started in 1919, was proceeding. Three 24,000 kW sets had been installed, and a very large saving in fuel costs had resulted. As compared with 1919, 8,000,000 kWh more was produced last year, with a reduction in coal consumption of 12,000 tons. The chairman mentioned the reduction of charges to consumers, and in conclusion dealt with the position of electricity supply in London.

The question of splitting the £5 shares into £1 shares was raised, but the chairman said that the directors thought that the present was not the right time to consider the matter, but it would receive careful attention.

City of London Electric Lighting Co., Ltd.

At the annual meeting on March 21st, the chairman (Mr. J. B. Braithwaite), in moving the adoption of the report and accounts, which were reviewed in our issue of March 16th, said that while the revenue had increased by £63,700, the working costs had shown a reduction of £23,900. The cost of fuel oil and coal had decreased by over £31,000 The extra profit of £87,650 was to be devoted to the alteration of consumers' appliances to conform with the standard system of supply; to the staff benevolent fund; leasehold redemption fund (an extra contribution); and to the establishment of a new feature, a dividend equalisation fund, for which £30,000 was to be appropriated. Considerable reductions in charges, which would benefit all classes of consumers, had been made at the beginning of the present year.

With regard to future prospects, the chairman said that although the company's activities were confined to the "one square mile" of the City of London, there was a tendency on the part of new buildings to go deeper into the ground and higher into the air, and so the company's output would continue to grow. He termed the increase in sales during the year from 35,930,846 kWh to 42,605,947 kWh a normal increase. The transmission of bulk supplies from the Bankside station was another direction in which expansion would be made. He had no fear that there would be any diminution in the company's output.

Chelsea Electricity Supply Co., Ltd.

The annual meeting was held on March 21st. Mr. W. R. Davies (chairman), in presenting the report and accounts, pointed out that the company's charges were now only 25 per cent. above the pre-war level, and he doubted whether there was any other commodity upon which the increase in cost was so small. Their policy of purchasing electricity in bulk from the Central Co. instead of generating it put them in a favourable position. The initial expenditure, which was the largest consideration, had been provided entirely out of profits. It would not be necessary to dispose of investments to raise the necessary capital. At a subsequent extraordinary general meeting resolutions were adopted approving: (1) the London Companies' Bill now pending in Parliament; (2) the division of the £5 shares (ordinary and preference) into five shares of £1 each; (3) new Articles of Association; and (4) an increase in the directors' fees.

County of London Electric Supply Co., Ltd.

In moving the adoption of the report and accounts (*vide* Elec. Rev., March 16th, p. 425), the chairman (Sir Harry Renwick, K.B.E.) said that the gross profit of £521,769 represented an increase of 52 per cent. over that of the previous year. While the gross receipts had increased by £126,150, the working expenses had fallen by £53,420. The sales of energy had increased by 7,000,000 kWh. The principal reductions occurred in repairs and maintenance, coal and other fuel, and salaries and wages, amounting in all to more than £16,000. This reduction was partly offset by increases in such items as rates and taxes. Although rates had fallen to a certain extent there was still considerable room for improvement. He advocated that municipal expenditure should be subject to a greater measure of Government control. The excellent results were not entirely due to lower working costs; much credit was due to the company's engineers for considerable improvements and economies.

The balance sheet showed the capital expenditure to the end of the year to be over £3,000,000. It was the policy of the board to refrain as far as possible from further expenditure upon the plant in the London areas in view of the erection of the large station at Barking, which would gradually supersede the two London stations for generating purposes. The net expenditure upon the Barking station amounted to £144,436 in connection with preliminaries; the main contracts were placed during the past year, but the considerable sums which these represented would not appear in the books until payment fell due. These contracts had been placed on very favourable terms and the work was proceeding satisfactorily. The investments had increased during the year; a sum of £163,565 had been invested in Government and trustee securities; a reserve of first-class character was being built up outside the company's business. An issue of 500,000 6 per cent. preference shares and 500,000 ordinary shares of £1 each, made in July last, had been considerably over-subscribed, and the shares were now at a substantial premium. The increased dividends paid by associated companies showed that these undertakings were in a flourishing condition and the company's revenue was correspondingly benefited. Referring to the re-organisation of London's electricity supply, the chairman said that the proposal to extend the companies' tenure was satisfactory. Only voluntary co-operation between the undertakers could solve the problem.

Sir Harry Renwick briefly reviewed the bright future before the electricity supply industry, making special reference to the schemes of railway electrification and the development of the domestic load which would provide cumulative business for all time.

The completion of the Barking station would materially reduce the working costs of the company, and there was no doubt that many further successes awaited the company in the near future.

Bournemouth and Poole Electricity Supply Co., Ltd.

Mr. J. A. Hosker (chairman) presided at the annual meeting on March 22nd. In presenting the report and accounts (*vide* Elec. Rev., March 23rd, p. 466), he said that, while the revenue had increased by £29,208 to £169,395, working costs had decreased by £17,890. The company was in a very unfavourable position as regarded rates and taxes; these amounted to no less than 0.55d. per kWh sold. A new item in the balance-sheet was £30,000 investments in Government and trustee securities; this represented the reserve moneys of the company. The increase in the number of connections and the energy sold during the first part of the current year rendered the prospect very satisfactory.

The division of the £10 shares of the company into 10 shares of £1 each was unanimously approved at a subsequent meeting.

South London Electric Supply Corporation, Ltd.

The annual meeting of this company, whose report and accounts were reviewed in our last issue, was held on March 22nd. The chairman (Sir Harry Renwick, K.B.E.), in his speech, dealt principally with the future of the supply industry, with special reference to the position in London in the light of recent events. He said that centralisation and unification were to be welcomed, provided the shareholders' interests were not unduly imperilled. At a subsequent extraordinary general meeting, a resolution for the division of the £5 cumulative preference shares and the £4 ordinary shares into shares of £1 each was approved.

Brompton and Kensington Electricity Supply Co., Ltd.

In presenting the report and accounts (*vide* Elec. Rev., March 16th, p. 427) at the annual meeting on March 22nd, Mr. H. R. Beeton (chairman) said that the sales and gross receipts continued to grow, showing an improvement of nearly 10 per cent during the year. The combination of this with lower production costs had enabled the company to reduce the charges to consumers. The Accessories Co. was also progressing and effectively contributing to the company's supply business. There were no outstanding events during the year apart from the capitalisation of profits and the division of shares into others of smaller denomination.

The chairman, commenting upon the proposals for the reorganisation of the electricity supply of London, said that, subject to necessary amendments, the Commissioners' scheme was not unacceptable to the companies, but it could not be discussed while its validity was in question. The Bill promoted by the companies met the circumstances in a better way; it was not compulsory, and any action which it was intended to take would be submitted to the shareholders.

Windermere and District Electricity Supply Co., Ltd.

Gross revenue during 1922, £9,227, an increase of £845; working expenses £6,114, an increase of £437. There was some reduction in fuel and oil waste and engine-room stores, but wages have cost more and a considerable amount was spent on engines, boilers and turbine. The company was also called upon to pay £86 in connection with the Electricity Commissioners' Inquiry held at Barrow-in-Furness. The Keswick Electric Light Co., Ltd., has again paid 5 per cent. on account of arrears of interest on debentures, and this company's net revenue account has been credited with £352 on its holding. £1,500 transferred to depreciation reserve account. Interest on debenture stock £1,000. The directors recommend that a dividend of 3 per cent. be paid on the preference shares, amounting to £750, leaving £567 to be carried forward. The board regrets that a larger dividend cannot be paid on the preference shares, but the time has arrived when the plant must be increased and it is impossible to raise more capital at present; the new plant must therefore be paid for out of earnings.

Arbroath Electric Light and Power Co., Ltd.

At the annual meeting, held last Friday, Mr. Geo. Balfour, M.P., stated that the profits for the year amounted to £6,880, plus £1,388, making £8,268, less £846 as interest charges paid and dividend of 5 per cent. paid on preference shares. £4,000 was put to reserve and renewals fund, £1,353 to payment of a dividend of 8 per cent., less income tax, on the ordinary shares, £63 to additional dividend of 1 per cent. on preference shares, making 6 per cent. for the year, and £2,006 is carried forward. Additional capital was required in connection with the development of the business, and the directors had meantime arranged to offer 15,000 ordinary £1 shares at par.

German Companies.

The South German Telephone, Apparatus, Cable & Wire Works Co., of Nuremberg, which is a subsidiary of the Felten and Guilleaume Co., reports net profits of 1,760,000 marks for 1921-22, as compared with 1,970,000 marks in the previous year, when a dividend at the rate of 15 per cent. was paid. The method of disposing of the profits for 1921-22 is not disclosed.

The Welter Electricity & Lighting Appliances Co., of Cologne-Zollstock, reports that further development took place in 1922 and all departments were fully occupied. The net profits amounted to 12,600,000 marks, permitting of the payment of a dividend at the rate of 100 per cent. on the share capital of 8,000,000 marks, which is now to be increased. Orders in the present year are said to be arriving in satisfactory numbers.

The Bavarian Telephone Works Co., of Munich, which is closely associated with the Berliner and Lorenz companies, reports having extended the installation business so as to include manufacturing by the erection of a new telephone factory. After having made provision for depreciation, the accounts show net profits of 1,300,000 marks for 1921-22, as compared with 80,000 marks in the preceding year, and the dividend is at the rate of 15 per cent., as against 10 per cent. in 1920-21.

A. Reyrolle and Co., Ltd. The report for 1922 states that, after providing for redemption of leases and depreciation of buildings and plant, the trading, including interest on investments and loans, resulted in a profit of £70,740 (against £54,826 for 1921). Including the amount brought forward the available profit is £82,280, against £64,662 for 1921. After paying the 7 per cent. preference dividend and a dividend of 12½ per cent. per annum on the ordinary shares (the same as for 1921), £25,000 is put to reserve (against £15,000 for 1921); £2,535 is written off goodwill account and £16,970 is being carried forward. During the year 385 preference shares were taken up and paid for by employés. Sales of the company's manufactures showed a considerable increase due to the completion of several large contracts and the profits earned were consequently higher than in 1921. The aggregate value of the orders received in 1922 was slightly higher than in the previous year, but prices were greatly reduced. The large proportion of the company's resources at present in loans and bank deposits is a reflection of the depression in trade, but there has been an improvement in demand during the current year. Preparations are being made to extend the works on additional land which was acquired two years ago, so as to provide greater facilities for production. The works have been maintained in an efficient state of repair, and provision has been made in the accounts for depreciation, and for corporation profits tax and income tax. Meeting held March 28th at Newcastle-on-Tyne.

Metropolitan-Vickers Electrical Co., Ltd. The profit available for 1922, including £92,815 brought forward, amounts (after providing for taxation) to £317,873, which has been appropriated as follows: To general reserve account, £35,000; to dividend on preference and ordinary shares at 8 per cent. and 12½ per cent. respectively, less income tax, £177,562; balance carried forward, £105,310. Orders received during the year, notwithstanding the prevailing trade conditions, show an improvement as compared with the previous year. Shipments from the works, however, show an important falling off as a consequence of the engineers' lockout, which occasioned a considerable dislocation of works in progress during the three months for which it lasted. The directors having regard to these circumstances, consider it a matter for satisfaction that the accounts show as well as they do. The directors decided to redeem the outstanding £142,700 of prior lien debentures, and gave the prescribed notice to the holders. This notice expired on December 31st, 1922, so that this debenture liability has disappeared from the balance sheet. The directors congratulate the Right Hon. Sir Edward Goulding, Bart. (a director) on his elevation to the peerage as Baron Wargrave. Since the last general meeting the following gentlemen have been appointed to the board: Maj.-Gen. Sir Philip A. M. Nash, K.C.M.G., C.B., Sir Vincent L. Raven, M.Inst.C.E., M.I.M.E., and Mr. Douglas Vickers (chairman of Vickers, Ltd.). Mr. J. Annan Bryce has resigned the chairmanship and Maj.-Gen. Sir Philip A. M. Nash has been elected to fill the vacancy. Meeting held March 29th, in London.

Clyde Valley Electrical Power Co. The balance of profit for 1922, including amounts transferred to contingency fund and second preference share special reserve fund amounts to £151,638, plus £51,547 brought forward. After paying the preference dividends and 8 per cent. on the ordinary shares, putting £50,000 to contingency fund, transferring to second preference share special reserve fund £4,482, writing down cost of second preference share issue, and writing off loan capital duty £10,546, £33,345 is to be carried forward. The business has again been adversely affected by the continued trade depression. The committee representative of all authorised undertakers in the West of Scotland Electricity District is engaged on the preparation of a scheme under Section 5 of the Electricity (Supply) Act, 1919, for improving the existing organisation for the supply of electricity in the district, and it is expected that the Electricity Commissioners will hold an inquiry for the purpose of considering the scheme in the latter part of this year. The Corporation of the City of Glasgow has made application for a Special Order to authorise it to supply electricity in a considerable portion of the company's area. The company is taking steps to oppose the application. Meeting held in Glasgow on March 28th.

Bristol Tramways & Carriage Co., Ltd. Mr. Samuel White (chairman) said, at the annual meeting on March 22nd, that again a strenuous year had been experienced. On the tramways alone the gross takings had fallen from £614,000 to £489,000; this was chiefly due to reductions in fares. In spite of the reduction, however, the number of passengers carried had declined by about five millions. Although there had been increased revenue from the carriage department, this increase bore no relation to the amount of work which had been carried out. Taxation was a smaller item, but the rates charge remained at about the same level. The result of all their efforts had resulted in a revenue of £80,000 upon the capital involved in the business of £2,600,000. The reserve now stood at £340,023, and if necessary this would be drawn upon rather than the ordinary shareholders should be without a reasonable return upon their investment.

Midland Electric Corporation for Power Distribution. Net profit for 1922 £139,876, making, with balance brought in £170,480. From this have to be deducted interest on debenture stock and loan £24,474, depreciation on plant, machinery, &c., £16,088, special depreciation on same £30,000, final amount written off commission and expenses of issues of debentures and shares and expenses during construction £4,287, cost of provisional orders written off £4,115, transfer to debenture stock redemption account £500, to reserve £5,000, preference dividend to December 31st £14,000, and interim dividend on ordinary shares of 4 per cent. £11,200, leaving £60,816. A further dividend on the ordinary shares of 6 per cent., making 10 per cent. for the year, is to be paid, leaving to carry forward £44,016.

Stock Exchange Notices.—Applications have been made to the Committee to allow the following to be officially quoted:—

Auckland Electric Power Board.—£350,000 five and a-half per cent. debentures, 1923 (bearer).

Dealings in the following have been specially allowed by the Committee under Rule 159:—

British Columbia Telephone Co.—10,000 six per cent. cumulative preference shares of $100 each, redeemable, Nos. 1 to 10,000; and £452,807 four and a-half per cent. first mortgage debenture stock.

Lancashire Electric Light and Power Co.—75,000 new ordinary shares of £1 each, fully paid, Nos. 152,364 to 227,363.

Midland Counties Electric Supply Co.—750,000 six per cent. cumulative preference shares of £1 each, partly paid and fully paid, Nos. 1 to 750,000.

Lancashire Electric Light and Power Co.—75,000 new seven per cent. cumulative participating preference shares of £1 each, fully paid, Nos. 137,501 to 212,500.

The undermentioned securities have been ordered to be officially quoted:—

British Columbia Telephone Co.—10,000 six per cent. cumulative preference shares of $100 each, Nos. 1 to 10,000; and £452,807 four and a-half per cent. first mortgage debenture stock in lieu of the preference shares and the first mortgage debenture stock of the British Columbia Telephone Co., Ltd.

British Thomson-Houston Co.—500,000 seven per cent. cumulative preference shares of £1 each, fully paid, Nos. 1,000,001 to 1,500,000.

Llanelly and District Electric Lighting and Traction Co., Ltd.—At the annual meeting on March 20th, Mr. A. R. Holland (chairman) said that the output during the year had increased by 3,323,887 kWh to 12,620,405 kWh. The 5,000-kW turbo-generator installed to meet the growing demand was in satisfactory operation, and greater economy in working was resulting. To provide funds for the further development of the company it was proposed to issue, from time to time, 100,000 preference and 100,000 ordinary shares of £1. At a subsequent meeting this was approved.

Brolt, Ltd.—According to the *Financial Times*, the accounts for 1922 show a loss on working of £16,898, after providing for depreciation of buildings, plant and machinery, and for all bad and doubtful debts. Notwithstanding general trade depression, the actual turnover was considerably increased, but the result of trading was adversely affected by the fourteen weeks' lockout in the engineering trade, the continued fall in selling prices, and the necessity for a further writing down of stock.

Cammell Laird & Co., Ltd.—The profit for 1922 was £195,906, and after adding £50,000 transferred from reserve, a dividend of 5 per cent. per annum is to be paid on the ordinary shares, carrying forward £31,233.

Mirrlees, Watson & Co., Ltd.—The net profit for 1922, after deducting depreciation, directors' fees, and other provisions, was £2,929, plus £14,911 brought forward. A dividend of 10 per cent., less tax, is recommended, carrying forward £4,086.

Companies Struck off the Register.—The following companies have been struck off the Register, and are thereby dissolved:—

Caerphilly Electric Supply Co., Ltd.
Cylectric Cookers, Ltd.
Marlborough Electric Supply Co., Ltd.
Reineke's Wireless Telephones, Ltd.

Neuhausen Aluminium Co.—The net profits of the Aluminium Industry Co., of Neuhausen, are reported at 4,242,000 fr. for 1922, as contrasted with 3,865,000 fr. in the preceding year. It is proposed to increase the rate of distribution from 8 per cent. in 1921 to 9 per cent. last year.

British Engine, Boiler and Electrical Insurance Co., Ltd.—In addition to the interim dividend of 10s. per share less tax, the directors recommend a final dividend of 15s. per share less tax; £17,000 to reserve; £8,180 to pension fund.

Brush Electrical Engineering Co., Ltd.—Dividend of 10 per cent. for 1922; reserve raised to £200,000; carry forward increased by £131,000, subject to taxation.

County of Durham Electrical Power Distribution Co.—Dividend of 6 per cent. on ordinary shares, carrying £1,317 forward.

Western Union Telegraph Co.—Quarterly dividend of 1¾ per cent., less tax.

Montana Power Co.—Quarterly dividend of ¾ per cent.

STOCKS AND SHARES.

Monday Evening.

In Good Friday week it is the custom for the Electrical Review to go to press a day earlier than usual, which necessarily shortens the time over which any kind of comment can be attempted with regard to stocks and shares quoted in the adjoining column. Business in the markets falls away to a noticeable extent, and there is little to talk about other than the common-or-garden record of what has gone up and what has gone down.

This being the case, it is more interesting—possibly more illuminating—to set out lists of stocks and shares showing the movements which have taken place during the first quarter of the year. Particularly is this so in connection with London electricity supply shares, some of the movements being little short of dramatic, while to make the comparison still more striking, we add the prices which prevailed at the end of 1921.

The course of the market has been steadily upwards during the past few business days. The Brompton & Kensington meeting, the County of London, and the South London meetings produced speeches from the respective chairmen which added further energy to the strength of the market, South Londons being a particularly good spot, with a 15s. rise at 7¼. County of London have recovered their dividend, and the market is looking for news of more companies in the near future joining the ranks of those which have already decided to split their shares into the popular denomination of £1 each. The following comparisons ruled on Monday this week :—

Electricity Supply Shares.

Ordinary.	December 1921.	December 1922.	Now.	Rise.
Brompton	6⅜	10½	36/-	15/6
Charing Cross	4⅜	7⅜	10	2⅝
Chelsea	3½	6½	8	1½
City of London	1⅞	2⅞	22	⅞
County...	8¾	1⅞	1⅜	⅜
Kensington	5⅛	8	8⅜	⅜
London	1	2⅛	4⅞	1⅜
Metropolitan	3⅜	6½	6½	—
St. James'	6⅜	9⅜	10½	1
South London...	2½	4⅜	7½	2½
Westminster	5⅛	7⅛	8⅛	⅛

The cable market has moved in the opposite direction from that pursued by electricity supply shares, the reason being, of course, that the recent developments in wireless, taken in connection with the broadcasting fever, have produced a slight apprehension in the minds of proprietors of cable stocks. Some of the holders got out of their shares, and prices gave way rather sharply about ten days ago, though they have rallied since, and, on the result of the three months' working, the changes are not great. It is worth noticing that Marconis have risen from 2¼ to 2⅜, after having touched 2 15/16 within the period :—

Telegraphs, Etc.

Stock or share.	December 1921.	December 1923.	Now.	Rise or fall.
Anglo-American Pref. ...	84½	103	104	+1
Eastern Extension	16⅝	19½	18⅞	— ⅝
Eastern Telegraph	166½	190½	184½	—6
Globe Ord.	16½	19⅜	18⅜	—1
Great Northern	26½	29⅜	28⅜	—1
Indo-European	27⅜	35½	35½	—
Marconi	1⅝	2⅛	2⅜	+ ⅛
United River Plate	5⅛	7½	7½	—
West India and Panama ...	¼	⅛	5/-	—5/-
Western Telegraph	16½	19	18⅛	— ⅛

The feature in Underground issues is a sharp rise in Metropolitan Consolidated, the price having gone ahead briskly on rumours (still unconfirmed) that the Great Western intends to take over the line sooner or later. All the stocks, however, in this section are higher, in sympathy with the steam stocks, most of which advanced on the completion of the grouping arrangements and the re-start of the Home Railway industry upon its own basis, freed practically from Government control. Although the Tube stocks were never in the same position as those of the steam lines during the war, the same influences worked in the market to depress or raise prices, and the improvement in Home Railways is not confined by any means to the electrical issues. Here are the comparisons :—

Railway Stocks and Shares.

Stock or share.	December 1921.	December 1922.	Now.	Rise.
Central London Ord. ...	51½	67	70	3
Metropolitan	26½	60	70	10
District	21½	47	53½	6½
Underground Ord.	2	2⅝	3⅛	⅜
" "A"	6/-	7/-	9/-	2/-
" Inc.	75½	87½	95½	8

Movements amongst miscellaneous shares have been quiet, matched against those in the market for electricity supply shares. The reason for this is that the manufacturing companies did but poorly last year as compared with the supply undertakings. This to holders, especially in the former cases, seems to be paradoxical, not to say somewhat exasperating, but the fact remains, to demonstrate how different are the sets of conditions which play upon the two classes. We append a few examples of the movements that have taken place :—

Manufacturing.

Share.	December 1921.	December 1922.	Now.	Rise.
Babcock	22	3⅛	3⅜	⅛
British Aluminium	15/-	16/-	18/9	2/9
British Westinghouse Pref.	1⅞	2⅛	2⅜	⅛
Callender's	1⅜	2⅛	2⅜	⅛
General Electric	18/3	18/3	20/3	2/-
Henley's	29/6	46/9	47/-	8d.
India-Rubber	⅝	⅞	⅞	⅛

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Nom.	Dividend. 1921.	Dividend. 1922.	Price Mar. 26. 1923.	Rise or fall.	Yield p.c.
	£					
Brompton Ordinary	1	12	12	36/-	—	£6 13 4
Charing Cross Ordinary ...	5	9	14	10xd	+½	7 0 0
do. do. do. 4½ Pref.	5	4½	4½	4⅞	—	5 7 5
Chelsea	5	6	10	8xd	— ½	6 5 0
City of London	1	14	15	47/6xd	+2/-	6 6 4
do. do. 6 % Pref. ...	1	6	6	23/-xd	+6d.	5 4 4
County of London	1	8	10	26/3xd	+1/-	5 10 6
do. do. 6 % Pref. ...	1	6	6	1⅛	—	5 4 4
Edmundson's Ordinary	3	Nil	—	2½	—	Nil
do. 6 % Pref. ...	5	12/-	—	4⅝	—	6 13 4
Kensington Ordinary	5	10	12	8⅞	—	6 13 4
London Electric	3	4	10	4⅞xd	+⅛	6 11 7
do. do. 6 % Pref. ...	5	6	6	5½xd	—	5 17 1
Metropolitan	5	7	8½	6½xd	— ½	6 10 9
do. 4½ % Pref.	5	4½	4½	4⅝	+ ⅛	5 9 1
Newcastle-on-Tyne Ordinary ...	1	Nil	2½	17/-	—	2 19 10
do. 5 % Pref. ...	1	5	5	15/9	—	6 7 0
do. 7 % Pref. ...	1	7	7	23/6	+6d.	5 19 2
Notting Hill, 6 per cent. Pref....	10	6	6	9½	—	6 9 9
North Met. Elec., 6 % Pref. ...	1	6	6	1⅛	—	5 13 0
Urban Ordinary	3	Nil	—	1½	—	Nil
do. 5 % Pref. ...	5	2½	—	4⅛	—	5 17 8
St. James' and Pall Mall ...	5	12	14½	10½	—	6 18 0
South London	4	7	10	7⅛	+ ⅜	5 10 4
South Metropolitan Pref. ...	1	7	7	1⅜	—	5 14 10
Westminster Ordinary	5	10	12	8⅝	—	6 19 3
Whitehall Elec. Invst., 7½ % Pf.	1	7½	7½	18/9xd	—	8 0 0

Home Rails.

		Dividend. 1921.	Dividend. 1922.	Price Mar. 26. 1923.	Rise or fall.	Yield p.c.
Central London Ord. Assented	Stock	4	4	70	—	5 14 2
Metropolitan	,,	2½	3½	70	+2	5 2 0
do. District	,,	1	3	53½	+2½	5 12 2
Underground Electric Ordinary		10	Nil	3⅜	+ ⅛	Nil
do. do. "A" ...		1	Nil	9/-	+6d.	Nil
do. do. Income	Stock	4	5	95¼	—	*5 4 10

Telegraphs and Telephones.

		Dividend. 1920.	Dividend. 1921.			
Anglo-Am. Tel. Pref.	Stock	6	6	104	—	5 15 5
do. Def.	,,	1½	34/6	22⅝	—	6 11 10
Chile Telephone	5	6	6	6½	—	4 16 0
Cuba Sub. Ord.	10	7	7	7½	—	9 6 8
Eastern Extension	10	10	10	18⅝	+ ⅛	5 8 10
Eastern Tel. Ord....	Stock	10	10	184½	+2	5 8 5
Globe Tel. and T. Ord.	10	10	10	18½	—	5 10 4
do. do. Pref.... ...	10	6	6	11½	—	5 6 8
Great Northern Tel.	10	24	24	28½	—	7 16 0
Indo-European	25	10	10	35½	—	7 1 0
Marconi	1	25	15	2⅜	+ 1/16	5 14 3
Oriental Telephone Ord. ...	1	12	12	2⅞	—	*4 7 3
United R. Plate Tel.	5	8	8	7½	—	*5 6 8
West India and Panama ...	10	Nil	Nil	5/-	—	Nil
Western Telegraph	10	10	10	18½xd	— ½	*5 10 4

Home and Foreign Trams, &c.

		Dividend. 1921.	Dividend. 1922.	Price Mar. 26. 1923.	Rise or fall.	Yield p.c.
Anglo-Arg. Trams. First Pref.	5	5½	12½	3⅞	—	7 6 8
do. do. 2nd Pref.	5	Nil	5½	3⅞	—	8 7 9
do. do. 5 % Deb.	Stock	5	5	84½	—	5 18 2
British Electric Traction Ord.	,,	4½	—	74½	+2	6 0 10
do. do. 6 % Pref.	,,	6	6	99	—	6 1 3
Brazil Tractions...	100	Nil	Nil	53	—1½	7 11 0
Brit. Columbia Elec. Rly. Pcc.	Stock	5	5	82½	—	6 1 3
do. do. Preferred	,,	5	90/-	77½	—	*6 1 3
do. do. Deferred	,,	3	124/-	89½	—1	*6 18 6
do. do. Deb. ...	,,	4½	4½	78xd	—	5 8 3
Lond. & Sub. Trac. 5 % Pref.	1	2½	3½	11/-	—	9 2 0
London United Tram. Deb. ...	Stock	4	4	64½	—	6 4 0
Mexico Tram. 5 % Bonds ...	—	Nil	Nil	81½	—	6 2 8
do. 6 % Bonds ...	—	Nil	Nil	61½	—	Nil
Mexican Light Common ...	100	Nil	Nil	22½	—	Nil
do. Pref.	100	Nil	Nil	52½	—	Nil
do. 1st Bonds ...	—	Nil	5	66½	—	7 11 3

Manufacturing Companies.

		Dividend. 1921.	Dividend. 1922.	Price Mar. 26. 1923.	Rise or fall.	Yield p.c.
Babcock & Wilcox	1	15	16	3⅜	+ 3/16	4 8 3
British Aluminium Ord. ...	1	10	5	18/9	—	5 1 6
British Insulated Ord.	1	15	15	2⅞	—	6 3 0
Callenders...	1	15	15	2⅜	—	6 15 4
do. 6% Pref.	1	6½	6½	1⅛	—	5 9 5
Crompton Ord.	1	10	5	16/3	—	6 3 1
Edison-Swan	1	10	Nil	4/-	—	Nil
do. do. 5 % Deb.	Stock	5	5	61	—	8 1 4
Electric Construction	1	10	10	28/-	—	7 2 10
English Electric	1	8	5	17/9	—	5 12 8
do. do. Pref.	1	6	6	18/6xd	—	6 9 9
Gen. Elec. Pref.	1	6½	6½	22/3	—	5 16 10
do. Ord.	1	10	5	20/3	+1/-	4 18 9
Henley	1	15	15	47/-	+9d.	6 7 8
do. 4½ Pref.	5	4½	4½	4⅝	—	5 6 0
India-Rubber	1	10	—	13/9	—	—
Met.-Vickers Pref.	2	8	8	2⅛	+	6 4 9
Siemens Ord.	1	10	10	20/9	—	Nil
Telegraph Con.	12	20	20	25½xd	—	*4 16 0

* Dividends paid free of Income Tax.

† New shares.

THE LETHAL PIPE.

By HUGH M. GOODY.

Daily papers are apt to be unpleasant reading—wars and rumours of wars, heavy taxation and trade depression; so the dismal tale unfolds itself. Yet there are occasional bright spots. For example, to the electrical man who has read only too often that irritating phrase "attributed to the fusing of an electric wire," there is something very satisfying in the diatribes of the daily Press anent gas poisoning.

But perhaps the matter should not be regarded from so selfish (I use the word broadly) a standpoint. Is it perhaps my duty to put myself in the shoes of the victims (though that would be asking too much of one to whom life is still sweet), or in those of the gas companies (though that would be unnatural)? However, one can but try.

To the victims I imagine the affair wears somewhat the aspect of a tragedy: whole families killed; a good proportion of the occupants of a street poisoned. One's mind goes back to air raids and the like tragic occurrences to find a parallel. The limit of irony is reached in the case of the man who did not even use gas, but was poisoned by a gas main running under or near his house! To be deprived of all the conveniences (!) of gas and then to meet such a fate!

And then one tries to view the matter through the gas companies' spectacles, which are gloriously rose-tinted. No, there is no deterioration in the pipes; they are in just as good a condition as the day they were laid down. And as for any difference in the quality of the gas—a sheer delusion! *And anyway* (says one gas apologist in the Press) *cases of gas poisoning are not so numerous as street accidents.*

In the face of such cheerful optimism, it seems a pity to sort the matter out in a cold-blooded way, but it appears to be necessary. During 1922 there were 112 cases of accidental death due to gas poisoning. This figure does not include suicides (numbering 300) or the innumerable army of gas users who are continually absorbing a minute percentage of carbon monoxide, which manifests itself in slight illnesses and headaches. A comparison of these figures with the street accident statistics seems about as irrelevant as a comparison with the casualties on a battlefield. Now, as to reasons: Household gas as supplied before the war contained about 6 per cent. of carbon monoxide. An admixture of straight household gas and water gas, such as is now generally supplied, contains 15 per cent. or more of carbon monoxide. Since anything over three-quarters of 1 per cent. carbon monoxide in air is certain death, the effect of even a slight escape of present-day gas is not surprising. While it may be true that the gas companies have not increased the proportion of carbon monoxide since the Gas Act of 1922, it can hardly be doubted that, speaking generally, they *have* considerably increased the proportion since 1914.

So much for the post-war dangers of gas. What of the less serious irritations—other, I mean, than those with which a patient public has always contended? Chiefly, there is the therm. Now, mathematically, the therm is a most innocuous unit, and it can be proved that to charge for gas by thermal efficiency rather than by capacity is greatly in the consumer's interest. Yet there is a huge volume of evidence that household gas bills all over the country have increased under the new system of charging, and that considerably. The expert witnesses before the Therm Inquiry Committee are inclined to attribute the difficulty to lack of intelligence in women, who, they say, "do not understand the conversion from cubic feet to the therm." A daily paper aptly rejoins that they understand only too well the conversion of the therm into pounds, shillings, and pence. The explanation is probably not very difficult. A considerable proportion of the companies raised their thermal standard on commencing the new system of charging. Thus the consumers' outlets, if left in their "pre-therm" state of adjustment, are passing more gas than is necessary. Of course, the gas experts will retort that the burners should either be turned on less fully or, in the case of lighting outlets, readjusted where possible, to pass less gas with the tap full on. The consumer, however, knows better. To judge (often in the dark) the exact position of a gas tap is a thing he does not pretend to do, while readjustment of a lighting burner either as to air or gas means more often than not burned fingers, broken mantles, and demolished globes. No; he finds it more comfortable and just as cheap to pay the extra on his gas bill. But the extra is undoubtedly there, and the beautiful theory of the therm does nothing to reduce it!

The gas consumer is therefore in the unfortunate position of paying rather more than usual for a greatly more dangerous commodity. Very naturally and very wisely he becomes restive. A member of the L.C.C. tabled a motion that the General Purposes Committee should consider "whether legislative or other steps should be taken to secure that gas companies should not spread illness and death by poisonous fumes, whether as a consequence of imperfect gas or faulty mains or pipes inside or outside buildings." The Committee was also invited to inquire "whether or not recent enterprise on the part of the electricity undertakings . . . tends to show that gas is no longer necessary to the running of a house, either in respect of lighting, heating, or cooking."

Widespread public discontent with the gas supply is obviously a state of affairs full of possibilities from the electrical point of view. It is in fact an opportunity which we shall miss at our peril. Yet how ready are we to take advantage of it? It is true that under reasonably good conditions gas is no longer either necessary or desirable in the running of a house. But we of the electrical trade know that the conditions are often so very far from "reasonably good." If the tariff is right, then the consumer cannot afford to carry out the wiring unaided. Or if both these difficulties are non-existent, then there is the troublesome question of "service charges" (which might be more properly termed anti-service charges). Or perhaps, while using electricity for lighting, the consumer cannot afford, in the absence of a hire-purchase arrangement, to buy the necessary cooking apparatus.

And so the road to the electrical home is paved with difficulties; but the greatness of our present opportunity should be a powerful plea for their removal. No new association is necessary, no fresh orientation of effort—just a determination on the part of each unit in the industry to do all in his or her power to smooth the path of the would-be electrical householder. May the measure of our opportunity be the measure of our success.

Electric Vehicle Census.—Census forms have been sent out by the Electric Vehicle Committee to central station engineers asking them to state the number of electric vehicles in their districts and to supply information about the energy consumed in battery charging. It is not mere statistical thirst that prompts this inquiry. The information is necessary in planning a campaign for the further development of electric vehicle transport and in estimating the value of the electric vehicle load to the central power station. If the question be examined from the broad national rather than from the immediate local point of view—and this is the committee's policy—there can be no possible doubt about the value of the electric vehicle load. It is to be hoped, therefore, that every central station engineer will give his assistance to the Electric Vehicle Committee in its quest for information, even though in the particular district with which he is concerned there does not appear to be—at the moment—much scope for electric vehicle transport.—*Electric Vehicle.*

EQUIVALENT TEMPERATURE TESTS.

Methods of Ascertaining Temperature Rise.

By Dr. M. L. KAHN, M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

The object of this paper (which was read and discussed before the South-Midland Centre of the Institution at Birmingham, on November 17th, 1922), is to critically analyse the various methods in use for ascertaining the temperature-rise of electric motors and generators, when it is not possible to subject them to full-load runs, a subject which is of great importance because the normal rating of electrical machinery is usually defined as the output which the machine can give continuously without exceeding certain temperature limits.

The, in general, two possible methods of testing, one in which the watt current is reduced to a negligible amount, while full voltage or over voltage is maintained (no-load run) and one in which the voltage is reduced and full-load current flows through the windings (short-circuit run), can be employed singly or in combination, and the paper describes critically how they can best be applied to various types of electrical machinery.

Direct-Current Motors and Generators.—The application of no-load and short-circuit tests to d.c. machines is very simple, and from the losses which take place during these two runs the temperature-rise at normal full load can be approximated to by adding the temperature-rise measured after each of the two tests.

For low-speed machines where commutation losses are usually low this will give quite satisfactory results.

High-speed machines have high losses and the summation of temperatures will give a temperature-rise higher than at full load. To allow for these discrepancies the temperature-rise obtained on the short-circuit run should be reduced by the percentage which the excess losses constitute of the total short-circuit losses; and this adjusted figure should be added to the temperature rise obtained on the no-load run.

Generally from 20 to 30 per cent. has to be deducted from the temperature-rise at short-circuit to obtain the full-load temperature-rise on the commutator.

The summation of the no-load and short-circuit temperatures gives a fair approximation of the temperature-rise of series field and commutating pole windings at full load.

In the case of the shunt field windings a summation of losses and temperature-rises is not feasible. The temperature-rise of the shunt field must therefore be derived by increasing the temperature-rise during the no-load run appropriately, (*a*) for machines fitted with an exhaust fan where the field windings are mainly cooled by air which has not passed through the armature in the ratio (full-load field current /no-load field current)^2. (*b*) For machines not fitted with special fans where the field is cooled by air which has first passed through or over the armature.

To arrive at the final result we deduct the temperature-rise of the air cooling the field windings during the no-load run from the observed temperature-rise of the field windings thus obtaining the difference in temperature of the coils and cooling medium. This figure is then multiplied by (field ampere-turns at full load-field ampere-turns at no load)^2 and the temperature-rise of the cooling air at full load is added to the result.

Induction Motors.—The two simplest equivalent temperature tests on induction motors are the no-load over-voltage test and the inverse rotation short-circuit test. The second method is much more definite and reliable. If the rotor of an induction motor is short-circuited at standstill, and a low voltage corresponding to the reactance voltage of the machine is applied to the stator terminals, the motor will take approximately full-load current in both stator and rotor. If the rotor is driven in a direction opposite to that in which it would run as a motor, the current remains practically unaltered, and when at full speed we can circulate full current in both stator and rotor with the normal conditions of ventilation.

The losses in the rotor during the inverse running tests are more than double the normal full-load rotor losses. The heating of the rotor is usually not of much consequence, except in high-speed motors with few poles, where the overhang of the rotor winding is large and has to be covered up with wide piano-wire bands. In this case the method may not be applicable unless the current during the test is adjusted to allow for this additional loss. This can be done by measuring the input to the stator with full stator current at standstill and at various speeds up to full speed with the machine running in the inverse direction. At the same time the power required to drive it is ascertained, the current being kept equal at all measurements. The friction losses are deducted from the driving energy. The remainder, plus the stator input, gives the total loss in the motor at various speeds, and this can be plotted in a curve in relation to the speed. This curve can be extended in the correct direction of rotation up to the full speed. At this speed the rotor loss is purely ohmic and is known from resistance measurements or calculations. The losses in the stator winding are obtained by deducting this rotor loss. These losses are equal at all speeds, so that the rotor losses at full speed in the inverse direction can now be found by dividing the total loss into stator and rotor losses. From this a current can be determined which gives a loss in the rotor corresponding to the full-load loss, by reducing the full-load rotor current in the ratio $\sqrt{}$(Full-load rotor loss/Inverse running rotor loss).

Running the machine in this way will give too low a temperature-rise for the stator, and two temperature runs may be required, one with full stator current to obtain the stator temperature, and the other with reduced stator current to obtain the rotor temperature.

In the case of h.p. machines with slip-rings rated to carry full-load current continuously, this difficulty can be overcome by connecting the rotor to a supply of normal frequency and short-circuiting the h.p. winding of the stator.

Experience has shown that the test gives, if anything, higher temperatures than are obtained at normal full load.

Alternators.—The simplest method is the combination of no-load and short-circuit runs. This test can be carried out in various ways.

For three-phase alternators a simple method is the reversed-coil method. If mesh-connected, full voltage can be induced in each of the three phases without any current flowing in the mesh circuit, as the voltages balance themselves. If the connection between two phases is opened and a direct-coupled, single-phase alternator is inserted, a current can be circulated in the mesh. The voltage required to send this current through the stator windings depends solely on the impedance of the stator windings, and as the resistance is small compared with the reactance drop the voltage required is the sum of the reactance voltages of the three phases. The armature reaction on the field due to the current flowing in the stator is small, as the magnetomotive forces of the currents in the windings of the three phases practically neutralise each other. The field excitation of the alternator is therefore little affected by the introduction of the circulating current, and although the current flowing in the stator windings is a single-phase current, no field fluctuations and corresponding losses occur in the poles and damping winding. The same result can be obtained by cutting out or reversing a few coils of one of the phases. The balance of the voltages induced in the three phases is thereby disturbed, and current flows in the mesh circuit, depending on the number of coils reversed. The machine can therefore be excited to give full voltage; the full current can be obtained in the stator windings at the same time by correct selection of the number of coils which are reversed, thus reproducing full-load running conditions. The number of coils which have to be reversed to obtain full current is determined by the following considerations.

In a machine with 10 per cent. reactance per phase, 30 per cent. of the voltage of one phase has to be introduced to overcome the inductive resistance of the three phases and circulate full-load current in the mesh circuit. This could be done by adding 30 per cent. of the total number of coils per phase or cutting out 30 per cent. of the coils. Instead of cutting out a number of coils we can obtain the same result by reversing half the number, as the voltage induced in the reversed coils counterbalances the voltage in an equal number of coils, so that the unbalancing effect is doubled. To overcome self-induction on a machine with x per cent. reactance, $3/2 \times x$ per cent. of the coils of one phase would have to be reversed to obtain full-load current during the run.

In that part of the circumference of the stator where no coils are reversed the magnetomotive forces of the current in the three phases of the winding neutralise one another and no reaction on the field takes place. Where, however, coils are reversed the armature reaction of the coils of the other phases is not neutralised and, in addition, their own armature reaction comes into play so that the armature reaction is equal to twice the reaction of the reversed coils. The field is, therefore, weakened at the exact position where the coils are reversed, and the voltage induced in the reversed coils is reduced. This must be taken into account in calculating the number of coils to be reversed, and can be allowed for by increasing the figure obtained from the reactance, as shown above, by about 20 per cent.

The fact that the fields are weakened at those parts of the circumference where coils are reversed will cause an unbalanced magnetic pull unless the reversed coils are evenly distributed round the circumference. As it is simpler to reverse adjacent coils, a bunch near the vertical centre line

in the top half of the stator may be reversed, where the resulting unbalanced pull will be downwards and will thus simply add to the weight of the stator. Alternatively, they may be near the vertical centre line in the lower half where the uneven pull is counterbalanced by the weight of the stator.

Rotary Converters.—For an equivalent heat run the machine is run at full voltage from the a.c. side as an over-excited synchronous motor. It will give a certain amount of leading wattless current which can be adjusted by the field excitation. On a six-phase converter a wattless current of about one-half of the watt current per ring at full load will cause I^2R losses in the armature winding equal to the full-load I^2R losses. The commutation losses will be greater than at full load, as the a.c. is not balanced by a corresponding d.c., and as the commutating poles are out of action. The temperature-rise of the armature will therefore be a little higher than at full load. The shunt winding will carry approximately the full field current, and the temperature-rise of this winding can, if necessary, be adjusted for full-load loss. The temperature-rise of series and commutating pole windings cannot be obtained by this method.

Discussion at Birmingham.

The discussion was opened by Mr. H. W. Taylor (British Thomson-Houston Co., Rugby), who warmly commended Dr. Kahn on the value of his paper.

Mr. B. Adair M. Boyce (Brush Electrical Engineering Co., Ltd.) confined his remarks to alternators. He pointed out that with regard to over-voltage and short-circuit tests on low-speed alternators the field system was not fully loaded in either case, and therefore the test did not represent full-load conditions. The equivalent full-load heating test used for the Ljungström turbo sets was the only test that actually gave all the conditions acceptable by consulting and inspecting engineers. The Brush Co. called it the zero power factor test, and it was carried out by first obtaining full voltage and then diverting the exciting current from one rotor until a wattless current, equal to the full-load current, circulated in the stators. The alternator with full excitation (namely, with the undiverted rotor) was then running under slightly worse conditions than at full load, as the power factor was zero instead of the value specified, usually 0.8.

Mr. J. G. Nixon (Brush Electrical Engineering Co., Ltd.), in referring to short-circuit tests, endorsed Dr. Kahn's statement that temperatures obtained by this method were generally high. Many individual cases of induction motors suggested themselves which would be expected to give final temperatures very much greater than full-load temperatures, when tested by the inverse rotation short-circuit method, because the rotor copper proportions and the characteristics of the machine would lead them to expect excessive losses in the rotor copper both from eddy currents and from a high ratio $12_S/12_L$ where 12_S=rotor short-circuit current corresponding to full-load current in the stator and 12_L=rotor full-load current. Temperatures more compatible with full-load heating might be obtained by applying full-load short-circuit current to the stator at a frequency below the normal, the rotor still to be driven at full speed.

The idea of the additional losses introduced by driving the rotor in the opposite direction to that of the rotating field was to compensate for the absence of full iron losses in the stator, and since the additional losses were practically dependent upon the frequency of the stator current, they could be adjusted by altering the frequency of supply. It was generally agreed that normal frequency gave results too high for effective comparison in the majority of cases.

To Mr. R. G. Jakeman, B.Sc., it seemed rather disappointing that the paper was limited to tests on single machines, since there were so many ingenious methods of testing two or more machines together. With regard to the running backwards test on induction motors, the author's method of obtaining full-load loss in the rotor appeared to be quite new. The loss-curve had to be extended by judgment over a distance along the abscissa axis equal to the length of the measured part of the curve, and that might give rise to considerable error, especially when the figures were taken in a commercial test-room. The author had not mentioned the Behrend alternator test, in which the field coils were divided into two parts and one part reversed, so that the machine worked partly as motor and partly as generator. The test gave trouble because of the unbalanced magnetic pull. Some years ago, however, Dr. S. P. Smith brought out a modification, in which he divided the field coils into several parts, thus equalising the magnetic pull. This method gave excellent results, because the currents in the stator and the field were both at their full value. The core loss also appeared to be normal. The method had the disadvantage, however, that it was rather awkward to alter the field connections, especially if the coils were wound with heavy strip. The reversed stator coil method for three-phase alternators was very good, but the field current was only slightly higher than the no-load value. The allowance of 20 per cent. in the number of coils reversed also took into account the fact that the reactance during the test was different from the reactance on normal load, and that it was difficult to determine accurately the normal reactance. It was possible to extend this method to two-phase alternators by dividing each phase into two parts and connecting in quadrilateral. One phase was divided in halves and the other into two unequal parts without reversing any coils. One half phase then delivered power to the other half, and the other phase carried wattless current. Single-phase stators could be divided into two unequal parts and connected in parallel. The test for rotary converters was also very ingenious, but it did not give the heating of the commutator.

Mr. H. Jack (British Thomson-Houston Co., Ltd.) stated that equivalent temperature tests were of great importance to the designer and manufacturer, but they should be equally important to the purchaser, particularly the consulting engineer. Not only were suitable heating tests required, but also tests of the mechanical strength and smoothness of running of the plant, and he was disappointed that the author did not deal with Hopkinson tests for synchronous and induction type a.c. machines. Equivalent temperature tests of a.c. machines, on the whole, he had not found very satisfactory. There seemed to be no tests which formed a real substitute for the full-load heat run. Methods which gave fairly good results for 25-cycle machines gave too high temperatures with 50- and 60-cycle machines. The results obtained with open-circuit and short-circuit tests of alternators (with correction for voltage and summation of temperatures) generally gave a temperature rise higher than on a full-load run. For induction motors he had used a method given by Collins and Holcombe which gave in most cases a temperature rise higher than on full load. He had also tested a large number of induction motors by the reverse rotation method, sometimes called the impedance heat run method. The results obtained in this way had on the whole been very approximate. Due to the higher frequency and current in the rotor, the temperature rise of the rotor was considerably higher than on full load, and accordingly affected the stator. The results obtained depended on how far the losses on the equivalent heat run compared with those on the actual load, and in the majority of cases they were different. On the whole, each case had to be considered alone, and the methods could generally be taken as giving only a rough approximation to the actual temperature rises on load. If it were possible to arrange some form of Hopkinson test with two machines this was very much to be preferred. In the case of large induction motors of, say, 1,000 h.p. and over, there did not appear to be any very satisfactory method of taking a Hopkinson test, as with machines of this size it was not very practicable to fit motors with pulleys of different sizes and run the one machine as an asynchronous generator, particularly if the motors were only provided with half couplings for coupling to a rolling mill or other load. If each induction motor could be coupled to a d.c. generator, then it was possible to take a load test combined with the d.c. generator, but this was a special case.

For rotary converters, equivalent temperature tests were very seldom necessary, as it was nearly always possible in the works of large manufacturers to find another rotary converter to run on load in conjunction with the machine under test. The fact that it had been possible to obtain full-load tests in the factory on rotary converters had been an important factor in the great progress made by the rotary converter in recent years.

Messrs. Wilson and Angold also took part in the discussion, which was replied to in brief by Dr. Kahn.

Stimulating Growth by Light.—Vegetables have been successfully "forced" in Germany by the aid of electric light. Over a plot of lettuces five lamps were arranged so that the light was diffused as uniformly as possible by reflectors, and the intensity of the illumination varied over the surface at different points. The lamps, reports the International Institute of Agriculture, were switched on for about six hours every day, beginning at dusk. Cabbage-lettuces illuminated from mid-November had, after twelve days, about two and a half times as many fresh leaves as those not illuminated. Moreover, the leaves of the "forced" produce were larger and firmer, and realised better prices. Plants exposed only to daylight required from four to five weeks, or double the time, to attain this degree of development. It would be possible, therefore, in practice to obtain in the same period of time two crops of lettuce instead of one. Counting the cost it was found profitable to use electric light. After seven weeks of prolonged illumination a comparison was made between the plants on the illuminated plot and those on the plot not illuminated. A 50 per cent. superiority of weight of the former over the latter in the green state, and 68 per cent. in the dried state, was found. The effect was equally good on beans and vetches. Illuminated strawberry plants yielded as early as the middle of March very sweet and scented fruit, while those not illuminated were four weeks later.—*Glasgow News.*

Hafnium.—It will be remembered that when Professors Hevesy and Coster, of the Copenhagen Physical Laboratory, reported that they had detected the existence of hafnium by X-ray spectrum, Dr. Alexander Scott, of the British Museum, remembered a certain mineral which he had prepared before the war from a black sand found plentifully in New Zealand. He sent a specimen of this mineral to Copenhagen, thinking that it would probably prove to be hafnium. Professor Bohr has since reported that the mineral is not hafnium, but that it contains mainly decanium and iron.

ELECTRICAL SALESMANSHIP.

Mr. H. W. Gregory, of the North Metropolitan Electric Power Supply Co., on March 16th gave the last of this session's series of salesmanship lectures organised by the E.D.A. The conference was again held at Caxton Hall, and Mr. A. G. Beaver, chairman of the Electrical Wholesalers' Association, was in the chair.

The title of the lecture was "The Relative Possibilities of Electricity in Different Trades and Classes of Consumer," and the speaker reviewed the general position as it had been revealed during the previous lectures, concentrating, perhaps, upon the supply side of the business. In this way Mr. Gregory addressed himself more to the engineers of small undertakings than to, as he put it, super salesmen, these engineers of small undertakings still being responsible for the development on the commercial side, although they had salesmen. The paper dealt with customers for electricity from two points of view: those who consumed to live, i.e., industrial users; and those who lived to consume, in which category were included private houses, clubs, public buildings, &c.

With regard to the first category, which included factories and workshops, electric vehicles, shops, &c., the possibilities were outlined in what have now become familiar terms, and it is therefore only necessary to point to one or two special matters to which attention was drawn. Stress was laid upon the necessity for the supply authority to lay mains as far as possible all over its area, and if inquiries for large supplies came from a part of the area where a supply could not be given for the moment, then a private plant should be recommended, but at the same time steps should be taken to see that the general lay-out and equipment should be such that it could easily be connected to the public mains when the public supply was available. It was recognised that difficulties arose through an unattractive tariff, and it was recommended that some modification of the standing charge should be made in the case of small power uses in shops. It was felt that this could be done without creating a dangerous precedent, in accordance with the nature of the business.

If a suitable tariff was offered it was pointed out that in the case of shops there was business to be obtained for cooking, signs, fans, small motors, window heaters to prevent condensation, and in numerous other directions.

Coming to the second class of consumer, Mr. Gregory said that his experience was that persistent advertising, coupled with the fullest attention and best service possible to such orders as were obtained, was really the solution of this problem. At the same time there should be a continuous stream of literature from the undertaking to all consumers and possible consumers on the routes of mains to keep them in touch with what was going on. The E.D.A. had studied the case from this point of view and was ready to help every undertaking in the country.

The final part of the paper discussed the sales staff and showrooms, as well as general propaganda, from the local office or showroom. Ability, enthusiasm and personality were stated as the main attributes of a successful salesman, coupled with absolute honesty to the consumer. The second necessity was a showroom. The public could not be expected to adopt what was, after all, a fundamental change in the habits of the household without being able to see actual examples of the apparatus in use; therefore demonstrations should be carried on more or less continuously. The showroom should be illuminated after closing time and a flashing sign outside was desirable. As to the activities of the undertaking during the summer time, this, of course, was the time when constructional work and new mains should be proceeded with and the possibilities for new business created. The laying of mains in a new district was a difficult problem to decide in the absence of a waiting list of customers, but the advisability was stressed of forecasting these lists in order that the work might be done at the cheapest time. Then the summer was often the only time the salesman could spare to make direct attacks upon the apathetic householder by personal visits. Again, obviously the summer was the best time to push the electric cooker, and he believed that the idea of a caravan or motor demonstration in the quieter roads of the districts was a good one and not impracticable.

In the subsequent discussion,

The Chairman said that it was interesting to notice from a table given by the speaker that jewellers and people whose sales depended upon a good display had been obtained to the limit, whereas those who sold food apparently were the slowest to adopt electricity, presumably for the reason that there was no need, or desire, to illuminate the goods too brilliantly. He heartily agreed with the absolute necessity of showrooms where apparatus could be shown in operation.

Mr. W. A. Gillott thought the author had attempted to cover too much ground in the paper, inasmuch as any one of the sections to which he had referred was subject matter for a lecture in itself. The author rather implied that there was such a thing as the born salesman but he did not believe that; it was a question of training. As to the poorer class districts, if these were developed with the aid of slot-meter installations supply engineers would be surprised at the revenue they would obtain.

Mr. E. Sharp criticised the action of some supply authorities in sending out leaflets intermittently. Some leaflets gave very little information and then asked the householder to apply at the electricity works for further information. Whilst agreeing that there should be a showroom, it was a controversial question as to the manner in which this should be stocked, i.e., by apparatus which had been bought or apparatus which had been loaned. One result of borrowed apparatus was that those in charge of the showroom took little interest in it and only remembered that it was there when the manufacturer wrote and asked if he should invoice it. He suggested that efforts should be made to get some of the national advertisers to use signs locally on a smaller scale than in the centres of the big towns. Alternatively they might consider lighting the posters at night in the suburbs and provincial towns.

Mr. H. T. Young said he was disappointed that more had not been said by the author about showrooms. Not enough had been said about hotels, where there was a tremendous amount of business to be done. There should be an effort on the part of the E.D.A. to concentrate on hotels, and especially on the question of heating bedrooms. The question of apparatus on sale or return for showrooms rested entirely with the manufacturers.

Mr. F. Selley (St. Marylebone Electricity Department) agreed that mains should be laid everywhere, as it was absurd to try and get business when there were no mains. He had a meter for the heating of bedrooms known as the tally-meter, in connection with which the hotel visitor obtained a tally, and by putting it into the meter on the apparatus obtained a certain amount of heating. This got over the difficulty introduced by changes in tariffs, as the hotel proprietor changed the tally according to the prevailing tariff. On the general question of salesmanship, the industry was suffering from too many people who were trying to increase the use of electricity but did not use it themselves. Every representative should be given full facilities for using electricity in his home. There should be a fixed charge for heating and cooking energy, otherwise this business would be killed. As an instance of the value of the cooking load, he mentioned that the average annual consumption of seven cookers in working-class flats, where he had installed them, was 1,200 kWh.

Mr. E. R. Morton (Sun Electrical Co.) advocated the development of hire-purchase of electrical apparatus. As to stocking showrooms, he felt it was wiser for the retailer to carefully investigate the merits of all the available apparatus and buy a stock of the best. Then he could tell his customers that he could recommend the apparatus from his own investigations.

Mr. Pooley (Pooley & Austin) speaking with regard to the manner in which one shopkeeper followed another in using electricity, mentioned a street which was crowded with stalls. One day he noticed that one of the stalls was lighted electrically by means of flexible wire taken from a shop near by, and now practically all the stalls were lighted in that way.

Mr. J. W. Beauchamp (E.D.A.) said the author had not mentioned public houses as a valuable source for development in the uses of electricity. As for electric signs, one of the things which held development back here was the local regulations as to signs.

Mr. C. H. Smith (Electric Fires, Ltd., Norwich) thought the best results were obtained by a good salesman working in conjunction with a good engineer. He was convinced that the poorer-class districts would be found to be the most profitable in the long run from the electric cooking point of view.

Mr. R. H. Lower (Norwich) urged supply people to take a little risk in getting business and not always want to be on "certs." They should not be afraid of a few bad debts if necessary. The big problem was the hot-water problem, and attention must be focused on some means for displacing the geyser at the same time as the coal cooker. An immersion heater or something with a 100 per cent. load factor was required.

Mr. Gregory briefly replied, and agreed that stocking showrooms was a difficult point. Nearly all his heating business was on the "All-purposes" rate, but he was not in agreement with the policy of sending a cooker round to a house for demonstration purposes, as the cost of wiring it up would be too big. He had a great belief in a motor van giving demonstrations, however, and intended to try that method this summer.

Manchester Steam Users' Association.—The annual report of the Committee of Management for the year 1922 states that the revenue reached the highest figure yet recorded. During the year the examinations of boilers carried out by the chief engineer (Mr. C. E. Stromeyer) and inspectors totalled 22,528.

THE BRITISH ELECTRICAL AND ALLIED MANUFACTURERS' ASSOCIATION (INC.).

The Annual Meeting.

Mr. B. Longbottom presided at the annual meeting held at the Connaught Rooms, London, on March 15th. The accounts for the year ended September 30th, 1922, were adopted and the annual report, which is abstracted below, was submitted. The chairman referred to a few matters in respect of which developments had taken place since the report was issued. Last year the chairman predicted a steady though not rapid improvement in trade, and that forecast had proved to be correct. They had had difficult and anxious times during the year, but goodwill and co-operation in and between sections had been maintained and had stood the strain in a manner which promised well for the success of their work in the future. The organising of the electrical and allied engineering section of the British Empire Exhibition had made excellent progress. The amount of space actually let was 60 per cent. of the whole, while an additional space of roughly 20 per cent., making 80 per cent. in all, had been applied for. There was, however, still much to be done, but they could go forward confident that their members and all those connected with the electrical engineering industry outside their membership would give that support which would make the section a great success. With regard to the World Power Conference, as far as this country was concerned, a committee was being formed to organise the engineering section, and representatives had already been nominated by the Institution of Civil Engineers and the Institution of Mechanical Engineers and were expected from the Institution of Electrical Engineers. With regard to countries abroad, the Secretary of the Federal Power Commission of the United States had been appointed chairman of the American Organising Committee, and he had the co-operation of the American Institutions of Electrical Engineers, Civil Engineers, Mechanical Engineers, and the Electrical Manufacturers' Council. In Canada the director of the Dominion Water Power Branch of the Department of the Interior was organising Canadian arrangements, and he had the support of Mr. Larkin, High Commissioner in London. The French Association of Electrical Manufacturers was forming a National Section, and in Italy a committee was being formed consisting of the General Inspector of Industry, the General Inspector of Industrial Education, the President of the General Water Council, and the presidents of the three principal electrical associations. In Norway and Sweden national executive committees were being formed.

The chairman went on to refer to several internal affairs, mentioning the Council's appreciation of the work of the Traffic Committee. In conclusion, he said that the B.E.A.M.A. was not out to advertise itself but to do sound and productive work on behalf of members, and in that way to benefit the industry as a whole.

The report was adopted. The Chairman declared the result of the ballot electing five members to fill vacancies on the Council for the session 1923-24. The proceedings terminated with a vote of thanks to the Chairman for presiding.

The Annual Report.

The report of the Council for the year 1922 began by stating that the severe trade depression which characterised 1921 and prevailed throughout most of 1922 made little appreciable inroad upon the membership roll, the loss on balance being just 5 per cent. of the total for the preceding year. That loss was, at the date of this report, almost made good.

Under such conditions as had prevailed the various committees and sections might have shown some signs of slackening of interest, but the Council was unable to detect any slowing down of effort or material diminution of output save perhaps in departments like education, which were always the first to feel the pinch of necessity. The allied departments of research and standardisation were well up to normal. Traffic had done very well, and the work of firmly letting £60,000 worth of space at the British Empire Exhibition in less than six months, with all its attendant labours of organisation, was a matter for congratulation.

Towards the close of the year there was a slight upward movement of the export trade barometer, and the industry had a corresponding share in the improvement. The close was, however, marked by a drooping tendency and the final figures showed us to be still a long way short of our pre-war standard. Certain large individual contracts obtained by members had been fairly well supported by general business of the more usual dimensions, and it was to be hoped that the tendency to an all-round steady advance would henceforward be maintained. "Trade with the Dominions" was now almost an axiom of the commercial world, and competition in that trade would probably be mitigated in proportion as the manufacturing advantages hitherto enjoyed by countries with inflated currencies tended to become balanced by considerable uncertainty about deliveries from those countries, and as our purchasing power increased with the return of our own currency to parity.

The Export Committee had continued to watch with interest the gradually diminishing ardour of the various countries in revising tariffs, noting that Continental countries with depreciated exchanges still continued to increase the rates of their specific taxes corresponding to the depreciation. The committee joined with the Federation of British Industries in opposing new Spanish Customs charges recently introduced with the result that substantial reductions were obtained and embodied in the new commercial treaty between H.M. Government and Spain. Dominion Customs duties and anti-dumping duties; the basing of these on home-market values; the intricate problem of double income tax; and the taxing of turn-over in cases where there was no visible taxable income, had all been the subject of action by the committee during the year. As the size of units increased traffic facilities for carrying the parts became of much importance; and the committee was studying in particular the railway facilities in India and Australia with a view to ascertaining maximum loads, dimensions, crane facilities, &c.

After a brief reference to the Beama Code the report goes on to refer to the British Empire Exhibition. The Council entered into an agreement with the exhibition company for the entire management, subject only to the general control of the executive council of the exhibition, of the electrical and allied engineering section of the exhibition. On December 31st more than half the space had been let, almost all of it to members of the Association. As the total rental value of the space in this section was about £120,000 the result was regarded as very satisfactory.

At the invitation of this Council members had tendered to the exhibition company, through the Association, for the supply of plant for a temporary turbine-driven power station, complete with switchboards and sub-stations, the value of which amounted to about £130,000. They had also offered to supply, if required, additional generating plant amounting in value to over £50,000. Both plants had been offered on loan on terms which represented only a small fraction of their value.

The arrangements for the World Power Conference were now well in hand. The Research Committee had been active in indicating the most fruitful channels into which existing researches should be directed and in making suggestions for the more effective distribution of work over the researches in hand and in effecting economies. Considering that the Electrical Research Association had only just ended its second complete year of work members were to be congratulated on the results. The report on the "Heating of Buried Cables" was expected to result in the saving to the industry of—and to the user in particular—tens of thousands of pounds a year. The results of the research on "Insulating Oils for use in Transformers and Oil Switches" formed the basis of (tentative) British Standard Specification No. 148, recently issued. This specification, even while in proof form, had evoked world-wide interest, and had already had the effect of bringing about a marked improvement in the quality of oils commercially obtainable.

The research on the breaking capacity of oil switches was still in progress, but the results already obtained indicated conclusively that if completed it would enable great reductions to be made in the cost of heavy switch-gear installations. This research had been rendered possible by the generosity of the Newcastle Electric Supply Co., which had placed some large generating plant at the disposal of the E.R.A. The rate of expenditure on this research was, however, beyond the existing financial resources of the E.R.A., and unless further financial support could be obtained the work might have to be shut down uncompleted.

The E.R.A. Council was planning to broaden the scope of membership of the E.R.A. by including supply undertakings and large users. The time had arrived when those outside the present E.R.A. membership who benefited by the results should be invited to take an adequate share in the financial burden.

Rules for wave-form, settled by a special Joint Standardising Committee, and accepted by the interested sections, had been issued as a supplement to the B.E.A.M.A. Standardisation Rules pending the publication of B.E.S.A. rules on this subject. Conferences had been held during the year between the Dynamo, Motor and Switchgear Sections and H.M. Electrical Inspector of Mines, with a view to obtaining a fuller interpretation of the regulations for the use of electricity in mines, and to defining more clearly the position of the manufacturer. As a result of the discussions it had been decided that any guarantee given by a member of the Association should take the form of a test certificate, issued by some recognised authority, that the apparatus had satisfactorily passed an explosion test when filled with and surrounded by the maximum explosive mixture of methane and air, or the equivalent, without igniting the external explosive mixture. Pending the establish-

ment of a Government testing station arrangements had been made by the Mining Department of Sheffield University, under the supervision of Dr. Wheeler, to undertake such tests and to issue certificates.

A meeting of the International Electrotechnical Commission was held in November last. In the important matter of rating of electrical machinery, the I.E.C. had, up to that time, recognised only the 50 deg. C. continuous maximum rating. It had been the practice, however, in this country in the case of practically all industrial machines and a considerable proportion of the larger machines, to use a 40 deg. C. rating with overloads, and the British delegates were successful in getting recognition by the I.E.C. of that rating for industrial motors and generators. The B.E.S.A. had now issued British Standard Specification No. 168 accordingly, which established the 40 deg. rating as the British standard rating for industrial motors and generators.

With regard to the work of the Traffic Committee, in the revision of the General Railway Classification of Goods by Merchandise Trains, several very important concessions were obtained which, taken together with new definitions for castings and the revised classification for machinery, would result generally in a saving to members of the Association estimated by the Committee at not less than £50,000 per annum. The Committee was now directing attention to the terms and conditions of carriage, and other matters which were still under consideration between the traders and the companies. The Committee had also had before it the question of the provision of special railway vehicles for the transport of large and heavy pieces, such as the stators of alternators, large surface condensers, and the like, of which a single piece might weigh from sixty to seventy tons. The railway companies were meeting the Committee in a very reasonable spirit, and had sent deputations to the Association with designs of special trucks to carry loads of seventy tons, which they were willing to construct on receiving the assurance that the trucks would serve the business of members. Among other concessions obtained as a result of conferences between the Traffic Committee and the railway companies, was a new clause in the conditions relating to the packing of switchboards. This new condition would be of great value to the manufacturers of large slate or marble switchboards.

Hitherto the companies had declined to carry machinery, by passenger train, exceeding two cwt. at owner's risk, but, as a result of negotiations with the clearing house, this restriction had been removed and pieces of any weight could now be sent "owner's risk," which should result in a considerable saving.

The energies of the Education Committee during the year were limited to work of a routine nature. Eleven scholarships were granted during the year, four in steam turbine, and seven in turbo-generator engineering. The City and Guilds examination, Grade I, was abandoned a few years ago in favour of a new system of certifying the qualifications of the artisan electrician introduced by the Board of Education. The new system was found not to give general satisfaction, and the Association assisted the Electrical Contractors' Association in an effort towards the restoration of the examination for 1922. After conference with the Board, the examination was restored. The Board and the Contractors were now in conference as to the nature of the practical training which candidates should have before certificates could issue.

On the subject of the training of Dominion and foreign students in English workshops, the Committee was at present engaged in an effort towards amassing statistics aimed at showing what the industrial countries of the world were doing in this now well-recognised department of industrial activity, *i.e.*, the making of "missionaries" and education of future purchasers in foreign lands. It was believed that the figures would reveal an extensive growth of this movement throughout the industrial world. The number of overseas students in members' works at the close of the year was 100, according to the returns received. The countries sending the largest numbers were (in order of numbers): South Africa, India, Egypt, Australia, and South America. With regard to the agitation in favour of our relinquishing payment of the Boxer Indemnity and diverting it to objects mutually beneficial to Great Britain and China, *e.g.*, the education of the Chinese, the Council was not behindhand in applying to the Government to be consulted with regard to any scheme formulated to that end as regarded training in electrical and allied works in this country.

The Council referred to the Sections for consideration a text of Contract Conditions issued by the Association of Consulting Engineers. The model set of conditions of the Institution of Electrical Engineers had not undergone revision during the year. Agreement had been reached between the Export Committee and the Institution on the text of the export set which was looked forward to in the last report, and the text now only wanted the formal sanction of the two bodies. Agreement had not yet been reached on the text of the proposed short set of "without-erection" conditions. The industrial solicitor reported that business, save as to very large contracts, had been fairly normal. The Federation of British Industries had not yet been successful in persuading the Government Departments that they should make any alteration in the terms on which they proposed that their work should be carried out.

The British Electrical Development Association, of which the Association was a founder member, during the last year—the fourth of its existence—raised its roll of members to a total of 691, an increase over the last reported figures of 132 members. Appreciation of the efforts of the E.D.A. in the work of electrical propaganda could scarcely be better expressed; and the Council again invited members of the B.E.A.M.A. to second those efforts by communicating to the director the earliest information as to new devices or developments so that he might take full advantage of them.

The report deals briefly with the I.P.S. and the Industrial Intelligence, Ltd., and then proceeds to refer to the Association Standing Rules regarding exhibitions as follows:—

"The partial suspension of the Standing Rule as to exhibitions, which expired December 31st, 1922, has been extended to December 31st, 1923. Members therefore continue to be free until that date to close contracts for exhibiting at any exhibition not wholly or mainly electrical. Complaints were made to your Council just before each autumn lighting season as to the great number of applications received by members from small municipalities and supply companies pressing them to exhibit at their local electrical exhibitions. The unsystematic way in which the promoters worked as regards overlapping and conflicting dates and the general convenience of members, was fully brought out by the complainants; and your Council decided that an effort should be made to bring some sort of system into the business and, after discussion with the Electrical Development Association, they accordingly made a new rule, of which a copy has been issued to members, to come into effect as of March 31st. The new rule relates to 'local' exhibitions only. A 'local electrical exhibition' is defined as any electrical exhibition promoted locally by a municipal corporation or supply company."

The number of members on the register at the end of the year was 190. There were three liquidations, five mergers in other companies, and three resignations. Five new members were elected.

DOMESTIC LOAD BUILDING.

Discussion at Swansea.

Mr. W. A. Gillott's paper on the above subject (an abstract of which appeared in our issue of December 8th, 1922) was read at the Western Centre of the Institution of Electrical Engineers, on March 19th, 1923. The chairman of the Centre (Mr. F. Tremain, Bristol) presided over a large attendance of members. Several ladies had also been invited to the meeting, and in consequence Mr. Gillott addressed many of his remarks to them in relation to the uses of electricity in the home.

The Chairman opening an interesting discussion said he was particularly interested in the heat storage appliances which were on the lines he himself had suggested for fully loading the station during the night time.

Mr. J. W. Burr (Swansea borough electrical engineer) said that he had not yet come across a two-part tariff which was satisfactory to both parties. The maximum-demand system seemed to be the best two-part scheme and certainly the most equitable. Any two-part tariff not based on the maximum demand was no improvement on the flat rate system of charging; he quite realised that two separate meters and wiring circuits were required in the latter case, but preferred to simplify the tariff at the risk of duplicating the installation. Heavier capital charges were incurred in giving the heating and cooking supply than was generally realised. Recently it was necessary for him to incur heavy expenditure on feeders to deal with the heating load which overlapped the lighting peak for several weeks in the year. He agreed that in order to develop the heating and cooking load it was necessary to supply at a low rate; at the same time it was only just that this class of consumer should bear its right proportion of capital charges. Not enough was made out of the indirect saving due to the use of electricity for all purposes. The saving in house decoration, wear and tear of furnishings and less domestic help, would in most cases cover the cost of electricity consumed. He agreed with the author that a model kitchen, fully equipped and in charge of a qualified lady demonstrator, should be provided in the town for inspection. Educating the consumer up to the economical use of the various apparatus, particularly cookers, was to him a more important matter. At the recent electrical exhibition at Swansea, it was found that while some ladies could cook a dinner for six persons, consisting of meat, two vegetables, and sweets, for a consumption of 2¼ kWh, others took three times that amount to cook the same amount of food; and he suggested that although it would obviously add to the cost of the installation it would pay to fix an easily-read meter on all cookers. With regard to the hiring out of cookers, he agreed with the author that a rental of 20 per cent. per annum on the net cost would be quite satisfactory from the suppliers' point of view. He did not, however, think that the consumer would adopt that view, and suggested that the makers should endeavour to put on the market a cooker

which would compare more favourably in price with the gas cooker, and that the supply authority should endeavour to hire out at a lower percentage of the net cost.

Mr. Stewart (Llanelly) agreed with Mr. Burr as to the necessity for education in the uses of electricity, and also as to charging a flat rate, it being almost impossible to drill into a business man the necessity of a two-part tariff.

Mr. Haslam thought that one point Mr. Gillott might have dwelt upon was the relative value of the results of electricity, coal, and gas cooking. He, himself, had figures showing a much smaller loss of weight in the cooking of meat by electricity than by either a coal fire or gas. One great point that had to be considered at the present time, whether by manufacturers, station engineers or users, was propaganda. At present nobody seemed to quite understand whose job it was. In this connection, he said, he did not think contractors were nearly as alive as they should be to the enormous possibilities, and he did not think they would get electric cookers and other appliances in the houses until they got something put into their end as well.

Mr. C. T. Allan favoured a two-part tariff.

Mr. H. O. Davies (Swansea Electricity Works) said that lower prices of electric cookers would popularise electricity.

Mr. Isaac thought that any form of night load would be more acceptable to the supply authorities than increasing their day domestic load. That was why he was impressed by their chairman's suggestion of heating the domestic water at night.

Councillor Cronin (Swansea Corporation) said that if there was the saving effected in building costs that Mr. Gillott had stated, Swansea in its next housing scheme should put up an all-electric house, and if Mr. Burr advocated it he would support him.

THE BANN HYDRO-ELECTRIC SCHEME.

An Important Project for Ulster.

The prosperity of Ulster depends primarily on its linen industry, which finds employment for thousands of people, from the growing of flax to the weaving of cloth. As is well known, power forms an important factor in the manufacturing costs of linen, more than one horse-power per operative being employed in the industry. It is estimated that the Ulster linen industry at present utilises 125,000 h.p., of which 55,000 h.p. is in use in Belfast, and the remaining 70,000 h.p. is consumed by the linen mills scattered throughout the six counties outside Belfast. The importance of cheap power to this staple industry will therefore be readily appreciated.

The need of cheap electric power for the development of industries in Ulster has been recognised by local industrialists for some time. An important point in this connection is the cost of coal at the various linen mill centres. This is distinctly high, and likely to remain so, owing to the large and growing demand in Ireland for coal for railways, shipping, and domestic purposes in comparison with the small output from Irish collieries, the strictly limited extent of the proved deposits of coal in Ireland, the high cost of mining Irish coal deposits, and the high costs of delivering coal to the various industrial centres. The average yearly output from Irish coal mines for the past twelve years has only been 86,000 tons, as compared with a yearly importation of 4,500,000 tons of coal into Ireland.

Under these circumstances the attention of industrialists has naturally been drawn to the possibilities of developing cheap hydro-electric power on the River Bann, which is known to offer very favourable facilities for such a purpose, and of distributing the electrical energy so generated to the various industrial towns within economic transmission distance. With this object in view the Bann Syndicate, Ltd., was formed last September, in which the Right Hon. J. C. White and Senator T. M. Greer, representing some of the chief local manufacturers, are interested, in association with a strong London financial group. Upon the formation of this syndicate Messrs. J. F. Crowley & Partners, Westminster, acting in association with Messrs. Meik & Buchanan, were appointed consulting engineers, and a particularly searching examination of the water-power possibilities of the river was made. As a result of the work of these well-known engineers, a detailed scheme has been prepared and is being embodied in a private Bill to be introduced by the syndicate in the Northern Parliament.

The proposed works, which include the regulating of the waters of Lough Neagh, will not only benefit Ulster by providing a cheap supply of electricity, but will also distinctly ameliorate the flooding conditions round the Lough, which, for many years past, have been the subject of serious complaints owing to the considerable loss caused by them to the farming community. This aspect of the proposed power scheme is one which should make as strong an appeal in the counties affected as the provision of cheap electric power. The works to be undertaken will enable the surplus water to be got rid of quickly, and thus altogether prevent serious inundations such as have been experienced in the past.

The accompanying map shows the location of the proposed hydro-electric generating station on the River Bann between the Movanagher and Garnroe weirs. The design of the scheme permits of development in stages to meet a growing power demand, beginning with a supply of 6,000 h.p., and increasing in steps until eventually upwards of 15,000 h.p. is developed. The whole of the power of the river will be developed at one station with a head of 27 ft., utilising 75 per cent. of the head available between Lough Neagh and high water at Coleraine. The total capital cost of the ultimate development will be something less than 1¼ million pounds, and it is estimated that power can be supplied even in the earlier stages of development in the proposed area of supply, where coal costs are much higher than in Belfast, at a rate far below that at which power is supplied to consumers in Belfast at present. It is believed that the power demands will greatly exceed the supply, particularly in the early stages of development, and arrangements are to be made to deal with applications for power in rotation.

In view of the many benefits that a project of this character should confer on a neighbourhood very poorly supplied with

Map of the Bann Hydro-electric Power Area.

electricity, yet furnishing a large market for power, it is surprising that steps were not taken years ago to secure the development of this important source, and the greatest credit is due to the public spirit and enterprise of the present promoters for the share they have taken in the matter.

Magnetic Searching for Metals.—For several years two Swedish mining engineers have tried a new method of electric searching for metallic veins. The invention—by Mr. Nathorst and Mr. Lundberg—during the last year was adopted by the State Department for Geological Exploration, says the *Manchester Commercial*, for the investigation of a maiden district in the north of the country. According to the official report now delivered to the Government, the result was the discovery of a great field of copper ore and sulphur pyrites. Out of the copper veins the State experts calculate a possible yearly production of 1,500 tons of copper. The sulphur pyrites would yield 100,000 tons a year—that is, about the total quantity needed by the Swedish pulp and paper industry.

THE ARCHITECT AND THE ELECTRICAL ENGINEER.

A Joint Discussion on Co-operation.

At a joint meeting of the Institution of Electrical Engineers and the Royal Institute of British Architects, on March 22nd, the discussion on the above subject, of which the report was commenced in our last issue, was resumed; the attendance was small.

Mr. Munby pointed out that the subject was a very technical one and the architect could not be expected to "rise to a high potential." Many jobs were too small to call in a consulting engineer, and the contractor must, therefore, continue to furnish both the material and advice. Much awkwardness resulted from the drawing up of specifications for sub-contractors by people who did not know their subject, and it might be desirable to prepare some sort of draft specification for the guidance of architects. Architectural students were not taught enough science at school; if any suggestions in that direction were put forward, he would do what he could to bring them to the notice of the Board of Education. Electrical engineers should first put their own house in order and make it possible for users to obtain electricity at a more uniform voltage than could be done at present; diversity of voltage was a great trouble to the architect. If they waited for the Commissioners' (Government) scheme, they would never see anything done; they must set about it themselves. One ought to be able to hire more apparatus than was possible at present; consumers could not be expected to purchase domestic appliances outright when they rented their houses on short leases; moreover, it was beyond the means of many to do so. He even suggested that electricity suppliers might install some devices free if the consumer undertook to use a definite amount of electricity.

Mr. J. Eck thought that the discussion had departed from the subject of co-operation. They must agree that the electrical engineer's part of any scheme was subsidiary to that of the architect; if they agreed upon that point, then architects would consult engineers more often than they had done. There was no question about the impartiality of the electrical consulting engineer, but they must differentiate between the consulting illuminating engineer and the electrical engineer After referring to the curative properties of arc light, he supported the suggestion that museums, picture galleries, and such like places should be adequately illuminated so that they could be enjoyed by night by the masses who had no opportunity to visit them by day.

Mr. R. J. Wallis-Jones said that the need for co-operation was extremely great. Excellent wiring and other rules existed, but it required considerable technical knowledge to apply them properly. He did not think architects had sufficient technical knowledge to use electrical apparatus to the best advantage, and it was not generally realised that periodical testing of installations was very necessary, in order to guard against deterioration and the dangers of dampness. The effect of moisture did not become apparent for some time after the damage had been done, but testing would often detect it.

Mr. A. F. Horner referred to heating and ventilation and asked if anyone had found a really efficient substitute for the coal fire? Wiring rules were very necessary, but their provisions must be carried out in a very broadminded way.

Mr. F. C. Raphail supported Mr. Wallis-Jones's remarks about periodical testing; nothing would last for ever, and cables and wiring did perish. Moreover, tests were apt to be misleading because wiring was liable to test well if undisturbed, but as soon as it was interfered with it went to pieces. Architects did not realise what sort of men electrical engineers were and that they knew their job. The extra expense of an electrical consultant's fee was nothing like so serious as had been suggested; it was a very small percentage of the total cost of a building and was often saved by obviating mistakes which rendered cutting away and making good after the building was completed. It was not necessary to use brass pipes in which to run cable, as Mr. Dykes had suggested at the last meeting; he had used much ordinary (and extraordinary) conduit, but had experienced no trouble with condensation. Lighting glare was talked about by everybody, but it was not difficult to go to the other extreme; they could illuminate properly if they were asked to do so. Mr. Beauchamp had made, perhaps, too much of the cheapness of electricity; he might have been a little more impartial so as not to convey the impression that they were no more than salesman. Chimneys were an "excuse"; they were most inefficient ventilators, not being designed for that purpose, created draughts, and in summer when most ventilation was needed most registers were closed.

Mr. Shepherd thought that much lighting was, to say the least, objectionable. He was quite in accord with the efforts that were being made for more co-operation, and thought that in the case of large buildings, architects were well advised to consult electrical engineers; they were bound to get trouble if they did not. Mr. Beauchamp's joint committee scheme was welcome because they needed assistance in many ways; for instance: What was the "life" of certain types of wiring? In how many years' time would certain plant or apparatus have to be renewed? Divergent voltage was a source of great trouble and architects could, unfortunately, only advise clients; they could not make them act up to it.

Mr. H. Cubitt said that most architects would like to install electric cooking devices, but the cost usually prevented their doing so and they had to fall back on gas; coal ranges were only used when clients wanted them. Ovens or other cooking equipment partially heated by the flue gases of coke or anthracite furnaces, the final cooking temperature being provided for by a limited use of electricity, offered more opportunity for a general use of electric cookery.

Mr. J. W. Beauchamp read a letter from Mr. W. A. Gillott advocating that the architect and engineer should get together as early as possible and that they should endeavour to eliminate fire places and chimneys as much as possible wherever electricity was to be had at reasonable rates. Where electricity was used the fire risk was very small indeed.

Mr. H. J. Cash thought that Mr. Beauchamp's suggested committee, in addition to the functions already mentioned, might with advantage also instruct illuminating engineers on architectural points. Usually they were quite satisfied if they were able to get a certain amount of light in a room, quite regardless of the direction from which the architect had intended it to come, or light and shade effects. Contractors were always ready to submit schemes, but it was always desirable to call in a consultant, because architects were not skilled enough to decide which of two schemes or tenders was the better. The disadvantage of hot-water heating systems was that one set out to overheat the air; it was radiant heat and not high room temperature that did the job. The disadvantage disappeared if they used a low-temperature general central heating system and "topped up" by means of electric radiators.

Mr. F. Hooper, in reply, said that their aim should be to introduce electricity into the humblest as well as the richest homes. The responsibilities of architects and engineers was very great, because their work influencd the welfare of their fellow-men so much. The responsibilities undertaken by the architect were now being realised better than they had been in the past and clients were therefore more ready to allow him to take advantage of the assistance of consultants. With regard to the lighting of museums, &c., he was understood to say that the I.E.E. had suggested taking the matter up.

Mr. J. W. Beauchamp, also in reply, pointed out that there seemed to be general agreement that the engineer and architect should meet "on the drawing board" rather than "on the foundations of the building." With regard to the hiring of apparatus, the gas companies almost gave away fittings and plant, but it should be remembered that the consumer did not get them free—he had to pay for them in some way or other. The desirability of periodically inspecting installations, especially in large buildings, was great and that was why he looked forward to the introduction of some form of graded wiring. With regard to testing, an ohmic resistance test was not enough and might be very misleading; surface wiring had the advantage of making visual examination possible. He who purchased coal bought work, and while they all desired to abolish the other fellow's fire because it made smoke, they were reluctant to abandon their own fires.

A Large Submarine Power Cable.—The Great Western Power Co., of San Francisco, on January 8th, completed the laying of the longest and largest submarine power cable ever installed. The cable is over seven miles long, and the cost to the company was approximately $500,000. The actual time consumed in laying the 38,500 ft. of cable was two hours and thirty-seven minutes. The cable is an 11,000-V, three conductor, 500,000-cir. mil cable, capable of transmitting 10,000 kW. It was laid to enable the power company to bring additional hydro-electric power into San Francisco, and in this way make possible a reduction in the steam generation of the company.

Because of the unusual length of the cable it was shipped from the factory of the American Steel & Wire Co., coiled on gondola freight cars instead of on reels. A length of 4,800 ft. was placed on each car, and nine of the largest gondola cars available were used in bringing the cable west. In laying the cable, the entire length of 38,500 ft. was coiled in circular pancake-like coils on a special cable-laying barge. All splices were made before the cable was coiled on the barge and the laying of the cables was one continuous process. In feeding the cable off the barge no manual labour was required. Because of the way in which the cable was coiled, it fed off the barge by its own weight and the tugs pulling the barge advanced the barge as the cable sank into the bay.—*Journal of Electricity and Western Industry.*

THE FARADAY SOCIETY.

Recrystallisation and Crystal Growth in Metals.

"Recrystallisation" as applied to metals is defined by Carpenter and Elam to mean the complete re-orientation of a crystal or a group of crystals. The new arrangement starts from new centres and is quite independent of the old system of orientation. The change always gives a refined structure. "Crystal growth" is taken to mean the rearrangement of certain crystals in a crystal aggregate to conform with the orientation of other crystals. During the process the latter increase in size by the addition of re-orientated matter. Hence the process always produces a coarser structure. Metallographists have recently been disputing as to whether recrystallisation and crystal growth can take place unless a metal has been subjected to plastic deformation. Similarly, it has been questioned whether crystals which have not been strained can grow. Some investigators have brought evidence from cast metals, but unless special precautions are taken a cast metal must suffer deformation in the chilling.

At the last meeting of the Faraday Society, Mr. Maurice Cook described some interesting experiments he had made with cadmium and brought evidence that under certain conditions unworked crystals can grow. Mr. Cook claimed that by his method of procedure, described fully in the paper, no stresses were set up in the metal during solidification. The rods of cadmium thus cast were annealed at 295 deg. C. for different periods, and the results indicated considerable crystal growth in the unworked specimens. The only difference between worked and unworked metals is that in the former the conditions favouring crystal growth are more favourable, because new centres of recrystallisation are formed by the working. Mr. Cook's results may not close the controversy, but his work is a useful addition to our knowledge of the structure of metals.

A paper by Mr. S. D. Muzaffar described experiments intended to settle the question of chemical combination between the metals lead and antimony, which form a series of alloys of considerable technical importance. The originality of the work lay in the method adopted. The electrical potential of the alloys was measured by means of a quadrant electrometer against a calomel electrode in potassium chloride, the alloys being immersed in various electrolytes, such as caustic potash, tartar emetic in tartaric acid, and lead nitrate solutions. The results revealed an identity of potential up to 98 per cent. antimony with that of lead, and they are taken to indicate that no solid solution and no chemical compounds are formed between the metals. This result is in harmony with the conclusions of other workers, but at the discussion some new evidence was brought forward, based on magnetic susceptibility measurements, seeming to indicate that at certain points lead and antimony do combine. So, here again, the matter awaits conclusive evidence.

Mr. F. H. Jeffery presented a study of electrolysis with an aluminium anode in solutions of sodium nitrate and potassium oxalate, the purpose being to ascertain whether a complex anion of aluminium is formed. In the former solution, such an anion is not formed; in the latter a complex anion is derived from the aluminium at the anode and its possible nature is discussed in the paper.

Finally, a group of papers—which do not lend themselves to brief abstract—were communicated by Prof. Porter, on behalf of Prof. D. B. Macleod, of New Zealand. These dealt with the viscosities of liquids and liquid mixtures, the relations between viscosity and coefficient of expansion, and between surface tension and density. Empirical formulæ are proposed to express these relationships.

Electric Coke Transporters.—Nineteen electrically-driven coke transporters, designed by Electricars, Ltd., in co-operation with the Woodall-Duckham Co., are in use at the Birmingham Gas Works, their work being to travel along straight sets of tramway rails, underneath the shoots of the vertical gas retorts, and remove the skip-loads of hot coke. The equipment is interesting in that it replaces a type of machine which in the past has given a good deal of trouble. The conditions at the base of the retort are difficult owing to the presence of moisture and acid gases; therefore a machine to work 24 hours in such surroundings must be exceptionally well protected. The transporters formerly used were operated from an overhead conductor, and later from a trailing cable, but both these methods were unsatisfactory and dangerous. The new machine derives its power from a battery of Edison accumulators, which supplies current to an electric motor of 3 b.h.p., which drives through a 20:1 worm gear and heavy Brampton roller chains on to a railway-type axle equipped with roller bearings. Provision is made for a safety interlock between the controller and the braking system, so that in the event of the operator's falling off the platform or meeting with some other accident, the release of the brake pedal opens the motor circuit and brings the transporter to a rest in a distance of from 20 in. to 24 in. Special lamps are provided on swivelling trunnions so that the light can be directed where necessary.—*Electric Vehicle.*

REVIEWS.

Applied Calculus. By F. F. P Bisacre, O.B.E., M.A., A.M.Inst.C.E. Pp. xv+446; figs. 14. London and Glasgow: Blackie & Son, Ltd. Price 10s. 6d. net.

This book has been specially written for science and engineering students who desire to acquire a working knowledge of the calculus, with only a slight mathematical equipment to start upon. It is, moreover, intended primarily for those who seek to gain this knowledge by private study.

We may say at once that this excellent book is admirably adapted for this purpose and will be found useful by a still wider circle of readers. Its special merit is due to its being written by a mathematician with the gift of clear and concise exposition, who is able to call upon his own experience as an engineer and practical scientist in the selection of examples and problems for solution. Although simply and interestingly written, it loses nothing in the strictness of its mathematical reasoning and forms a safe guide to the elements of the calculus, even for those who hope to pursue their mathematical studies in more advanced treatises in the future.

Perhaps the most definite line of demarcation between books on the calculus which are merely utilitarian in their aim and those which refuse to sacrifice mathematical accuracy for the sake of simplicity, is to be found in the treatment accorded to limits and limit ratios. The author of the present volume is specially successful in giving a rigidly consistent and mathematical introduction to this subject, while making it both clear and interesting. Indeed, the whole of the theoretical treatment is marked by simplicity and thoroughness. Its special appropriateness to the needs of the engineering student is due largely to the omission of topics and processes which are chiefly of academic interest, and a wise selection and full discussion of those aspects of the calculus which lead to useful results and provide the means of dealing with actual physical problems.

The last three chapters are devoted to the application of the methods of the calculus to the solution of actual problems, and deal respectively with electricity and magnetism, chemical dynamics and thermodynamics. These chapters are by no means the least interesting in the book, since the problems are discussed in such a broad and reasoned way that the mathematical treatment falls into its proper place and the physical problem or principle is retained as the centre of interest.

Throughout the book arguments and calculations are set out with admirable clearness, materially aided by bold diagrams and the choice of excellent type arranged to give varying degrees of prominence to the subject matter.

A specially pleasing feature of the book is due to the writer's endeavours to give it a wider and more human interest than is to be found in the more conventional text-book. Happily chosen quotations form mottoes for each chapter, while portraits of great mathematicians, physicists and chemists are given at intervals, and biographical notes appropriate to the portraits are given at the end, and indicate the contributions to the advancement of knowledge made by these leaders of scientific thought. Further, we find here and there references from historical or literary sources used to illustrate a mathematical point. A specially delightful example of this is the quotation from Portia's speech in the famous trial scene in which "limits" are set to the allowable divergence from Shylock's pound of flesh. The discussion of "large" and "small" quantities based on the "pound of flesh" and the "one poor scruple" is both refreshing from its originality and illuminating from its aptness.

The book is to be cordially recommended to students of engineering and science who seek to gain a grounding in the calculus.

Real Mathematics. By Ernest G. Beck, A.M.Inst.C.E. Pp. viii+306; figs. 103. London, 1921: Henry Frowde and Hodder & Stoughton. Price 15s. net.

This is not a students' text-book in the ordinary sense, since it contains no examples for practice and appears to be intended as a sort of critical companion to a class-book of the ordinary type.

The impression one gains in reading it is that the author suffered in his student days from a succession of bad or inefficient teachers and made up his mind that all teachers were bad. One gathers that he then set himself to devise a system of instruction to suit his own needs, without realising that there are in fact many good teachers and not a few books which are not wholly to be condemned. The final result as here presented shows that the author has in some cases discovered for himself methods and points of view which are familiar to all good teachers, while in other cases he substitutes his own arbitrary and unscientific interpretations of mathematical processes in defiance of their true meaning. Thus, while the book contains certain good points, it contains many others which are bad and misleading.

Two examples may be given of the author's "bad" points. The first is due to his complete failure to distinguish between the operations of *mathematics*, which deal with number only, and the *physical* interpretation which we give to the results of these mathematical operations. This misunderstanding leads

him to make the following astounding statements on p. 75: "The *n*-th root of a given number is of the same nature as the given number." "The square root of 100, if the 100 things be men, is 10 men; the square root of nine pencils was found to be three pencils." "The square root of an area is an area." "The square root of 16 square inches is four square inches." How the author proposes to find the square root of a man, and what the verdict would be after the event, is not clear.

The other example of inaccurate reasoning to which we will refer arises from the author's lack of a clear conception of a ratio. His ideas of a "rate" woul dbe most difficult to apply in problems when the "rate" is a variable number.

What could be more fundamentally misleading than the following statement (p. 147): "A 'rate' represents a group of real things, just as do all other mathematical symbols or expressions. If we find that liquid flows from the outlet of a pipe at the *rate* of three gallons per minute, the discharge is simply three *gallons of liquid*." Again, the same confused reasoning leads to the statements "It is important to notice that a velocity is essentially a *distance*" (p. 284); or, once more, "It is important to notice that it follows from the foregoing consideration that acceleration is, in fact, a distance."

Enough has been said to show that the student may be seriously misled or confused, if he takes the book for his guide, and, despite some interesting features, *e.g.*, the graphical treatment of square root and factorisation, he must be seriously warned that the defects are too fundamental and far-reaching to make the book useful, even as an adjunct to a more orthodox class-book.

It only remains to be added that the style is intolerably diffuse and wordy. The argument is allowed to ramble on until it is often difficult to find any clear statement as to the object of the discussion, or what conclusion is ultimately arrived at.

The Perry Auto-Time Morse System. By F. W. Perry. Pp. 16. London: The Wireless Press, Ltd. Price 6d. net.

This little book, written by a late wireless instructor in the R.A.F., should be useful to those who wish to acquire rapidly a working knowledge of the Morse Code. A list of wireless stations, with call signals and wave lengths, is given to assist the beginner in improving his new knowledge in a practical manner.

Advanced Laboratory Practice in Electricity and Magnetism. By E. M. Terry, Ph.D. Pp. xi+261; figs. 130. London: McGraw-Hill Book Co. Price 15s. net.

The author explains in his preface that the subject-matter of this book covers the work in electricity and magnetism given to third-year students of electrical engineering at the University of Wisconsin; it thus represents the ground of pure electrical theory required in the degree course.

The first half of the book contains material adequately described by the title, and consists of accounts of the theory of electrical and magnetic measurements, clearly written and well arranged, though with no special feature to distinguish it from standard text-books on the same subject. The methods described are all well-known, and no novel methods or proofs are attempted. References to sources of fuller information on the various measurements described are frequently given, and students are expected to turn to these sources as a useful exercise in extending their reading.

In the second half, the book somewhat changes its character and becomes mainly a treatise on the theory of certain electrical phenomena and devices, with occasional experimental exercises. This section is hardly what one would expect to find under the title chosen by the author; though the explanation of the book's purpose, given in the preface, renders it clear why many matters not suited for experimental treatment have been included in the volume. There are, of course, many subjects of electrical theory which may be of great importance to the electrical engineer, although they cannot be classed as "electrical engineering." Some of these might easily escape any serious treatment in a technical syllabus and are included by the author in his lectures on electricity and magnetism, and appear accordingly in the present work.

The following are some of the subjects dealt with in this way in the later portion of the book:—Transient Phenomena, including oscillatory and non-oscillatory discharge from a condenser, resonance, and the conditions for its appearance; Alternating-current Bridges, including an account of various methods of obtaining and detecting alternating, interrupted, or oscillating electromotive forces for use with bridges of this type; Conduction of Electricity through Gases; Electron Tubes, by which is meant two- and three-electrode thermionic tubes.

The chapter on the Conduction of Electricity through Gases is a clear and concise summary of the more important general results of modern electrical theory, with four suggested experiments, dealing with the resistance of a vacuum tube, the variation in the electrostic field strength along the tube, the measurement of e/m and the velocity of an electron, and the measurement of ionisation by radio-active substances.

In the chapter on the principles of the thermionic tube, there are five experimental measurements suggested for the student, *viz.*, the current-potential and current-temperature characteristics of a two-electrode tube, the static characteristic for a three-electrode tube, the amplification factor, and the plate-filament resistance of a three-electrode tube, and the study of a thermionic rectifier.

The experiments are enumerated here in detail because of their interest as suggestions for the extension of the laboratory work of the electrical engineering student into realms formerly considered the preserve of the pure physicist. There can be no doubt that every well-trained student of electrical engineering should become acquainted early with the recent advances of electrical science, and it is also desirable that he should himself handle some of the simpler types of apparatus employed for measurements of ionisation and thermionic currents. It is good, therefore, to find these needs provided for in the form of definite laboratory exercises.

The book as a whole might be criticised as containing more theory than is necessary for a book on laboratory practice and less theory than would suffice to make it self-contained in this respect. No doubt it is designed specially for the needs of a special type of class, and would not fit every college curriculum. Taken as a whole, however, it can be commended as a useful guide to the laboratory for those non-technical measurements which are of great and fundamental importance to the technical student.

The book is excellently produced and the diagrams are clear, though this cannot be said of all the photographs of instruments. There are no actual results given for the experiments described; in certain of the measurements this would have been a valuable addition to the discussion given.

The Philosophy of Management. By Oliver Sheldon, B.A. (Oxon.): Pp. xvi+296; figs. 8. London: Sir I. Pitman and Sons. Price 10s. 6d. net.

Probably no science has of recent years received so much attention at the hands of business writers as that devoted to "Management," and yet comparatively little headway has been made. This may be due to the fact that the application of modern management is for the most part by a policy of adjustment, each individual concern having its own ideas, and adopting these ideas to cater for the specific circumstance, without real appreciation of the principle for which "management" stands.

In "The Philosophy of Management" the author has devoted his attention to basic principles, setting forth, in a comprehensive manner, the real meaning of management in all its phases. The "new spirit in industry" permeates its pages, and the human element looms largely in a really practical work. "Industry cannot be rendered efficient while the basic fact remains unrecognised that it is primarily human. It is not a mass of machines and technical processes; it is a body of men. It is not a complex of matter, but a complex of humanity. . . . ."

Management implies a thorough understanding and appreciation of men and materials, and this work goes full into the merits of the case, marshalling facts and quoting references in a manner calculated to excite the interest of the modern industrialist. The author goes "all out" for industrial reform, enlarging upon the growing aspirations of labour, and showing how these can be fostered and directed by a wise and foreseeing management. It may be that many of his theories are too sweeping to secure general support (for the present, at all events), but his contentions strike at the root of the matter, and are undeniably the outcome of a deep and profound study of industrial problems.

The functions of management are dealt with at length in the chapters devoted to "Labour Management" and "Production Management," while the principles underlying factory organisation—(*a*) *Function*, or the work to be done; (*b*) *Objective*, or the ideal and object; (*c*) *Faculty*, or the human capacity in work; (*d*) *Relations*, or the relationships, administrative and physical, between the faculties employed; and (*e*) *Method*, or the way in which work is done—are amplified in a convincing manner.

The importance of the foreman is emphasised, and he is recognised as an integral unit in modern management. His achievements in the past, when he was "expected to be a teacher, statistician, psychologist, engineer, technical expert, clerk, and, amidst all, a leader of men," receives due recognition, but it is pointed out that whilst his efforts to carry out such a medley of duties were probably adequate in the days when industry was a matter of sheer effort, tempered neither by science nor theory, it is quite impossible to carry out such a medley of duties in accordance with the standard of a scientific age. "The British foremen, as a class, are probably the sturdiest element in industry to-day, but they are facing a hopeless future if they continue in the way they have come."

But so long as the foreman is regarded as the "sergeant major" of industry, he cannot occupy the place assigned to him in modern management. "We select our foremen largely to make them managers," says the author, but this has not been so heretofore. Few indeed are the rankers who have gained "commissions" in industry, and even in this book the recommendations relating to the training of foremen suggest that only in exceptional circumstances will the foreman qualify for the higher branches of management.

This book is for the industrial administrator, for it formulates the plan upon which his activities are based. There is plenty of energy in management to-day, but the results are disappointing. "Systems" are introduced into the factory, and are speedily modified, due to a lack of co-ordination which is the result of an unsettled policy. "The Philosophy of Management" gets to the root of the matter, and the theories advanced should certainly be put to the test. The book is a study, which must in its turn be studied; and it should be read, not once, but twice or thrice, so that the reader may thoroughly grasp the significance of its message, which cannot fail to broaden his outlook and assist him in his endeavours.

Electricity in Agriculture. By Arthur H. Allen, M.I.E.E. Pp. 121; figs. 35; 4 tables. London: Pitman & Sons, 1922. Price 2s. 6d. Decimal Classification, 63 : 621.347.

It is always somewhat difficult to write a book that deals with two separate industries. Hence the author of this book must be congratulated upon the production of a work that, for the first time, in the form of a primer, tackles the dual arts of applied electrical engineering and modern practical agriculture. In a comparatively few pages a vast field is dealt with in a very clear and concise manner, equally intelligible to the electrical engineer and the farmer. The former qualification is very important in the opinion of the reviewer, for it is his experience that most electrical engineers know less (though they are apt to think that they know more) about the applications of electricity to farming than the farmers themselves.

In the first few chapters is discussed the all-important question of obtaining and distributing the necessary electricity supply. Sound advice is given, *i.e.*, from the farmer's point of view. *Inter alia* metallic-sheathed wire is suggested; however, this would not be good practice on farm work. Further, the type of fitting illustrated might be substituted with advantage under farm conditions.

Very rightly the domestic comforts of the farm-house receive attention. This is by no means an unimportant point, for if the comforts of the city can be added to the advantages of the country it will be all the better for agriculture.

One of the most important chapters is that on electric ploughing, for while considerable attention has been given on the Continent to the electric driving of farm machinery, the same cannot be said of the cultivation work. This cultivation work absorbs an enormous amount of power, and hence the importance of carrying it out economically—and, so far, the electric way has proved itself very considerably cheaper than other methods.

Altogether this little book forms an excellent introductory electrical review of electro-farming. There are a few highly-technical slips on the farming side, but very few farmers would notice them. After all, the object of this book is undoubtedly to make the subject self-evident to those whose interests lie in taking advantage of, and in making every possible use of, the applications of electricity to agriculture. It certainly demonstrates that the usually assumed difficulties are really quite easily surmounted, hence it may well be claimed that the book has succeeded in its object.

The material of its contents bears evidence of careful noting of progress in electro-farming over many years. The bibliography, at the end of the book, is a little meagre, even for a meagre subject, so far as literature is concerned. However, the most important references are mentioned. The illustrations are well chosen, but, of them all, the cover design most appealed to the reviewer, as it is so representative of an up-to-date Continental farm—and of the average British farm a decade hence.

R. Borlase Matthews.

"The Extra Watt."—Under the pen-name of "Lallime," a writer in the *Commonwealth Engineer* describes a rather novel "boost" given to a motor-car starting battery. The battery was practically exhausted, and as there was no crank to the engine something had to be done to render electric starting possible. It was remembered that the electrolyte of a battery possessed a negative temperature coefficient, and it was thought that by raising the temperature of the battery the resistance would be considerably reduced, and the chemical activity stimulated. The battery was therefore removed and placed nearly up to its terminals in a bucket of hot water, raising its temperature to about 200 deg. F. When the battery was re-connected and switched on the engine was started with ease. It is not suggested that this method should be adopted as common practice, but in times of emergency it may be necessary to obtain from a battery the "extra watt."

The Wimbledon Case.—At a meeting of the Wimbledon Council on March 20th, a letter was received from the Mayor, referring to the libel action brought by Mr. H. Tomlinson-Lee, formerly the Council's electrical engineer. The Mayor, who offered to resign, disclaimed any animosity against Mr. Lee, and disagreed with the verdict. A vote of confidence was passed by the Council.

NEW PATENTS APPLIED FOR, 1923.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Patent Agents, 285, High Holborn, London, W.C. 1.

6,746. "Head telephones." W. H. Woods. March 8th.
6,751. "Telegraphic apparatus." W. Vogelsang and Vox Maschinen Akt. Ges. March 8th.
6,757. "Electro-magnetic impulse responding apparatus for telephone systems." Automatic Telephone Manufacturing Co., Ltd. (Automatic Electric Co.). March 8th.
6,760. "Wireless telephony." P. Elphick. March 8th.
6,761. "Time switch." Landis & Gyr Akt. Ges. March 8th. (Switzerland, August 17th, 1922.)
6,766. "Prevention of overheating electrically-heated irons, &c." C. A. Simpson, March 8th. (New Zealand, April 1st, 1922.)
6,771. "Fault detector for testing electric circuits." H. E. S. Holt. March 8th.
6,773. "Synchronised asynchronous machines." Compagnie Générale Electrique. March 8th. (France, April 22nd, 1922.)
6,775. "Spiral filaments for electric lamps and thermionic valves, and machines for winding same." F. H. Anstee. March 8th.
6,784. "Apparatus for reception of wireless telegraphy, &c." H. G. Cameron. March 9th.
6,848. "Miners' electric safety lamps, &c." W. J. L. Sandy. March 9th.
6,860. "Electrodes for arc welding and metal cutting." W. R. J. Britten and District Chemical Co., Ltd. March 9th.
6,866. "Insulators for electric railways, &c., having overhead wires." Sir P. Dawson and F. W. Fawdry. March 9th.
6,868. "Electric swivel for telephone cords, &c." W. F. Grove. March 9th.
6,875. "Electric connectors." E. S. Russell. March 9th.
6,883. "Tube-feeding apparatus." British Thomson-Houston Co., Ltd. (General Electric Co.). March 9th.
6,884. "Electric measuring instruments." K. Edgcumbe, E. I. Everett, and F. E. J. Ockenden. March 9th.
6,892. "Electric heating elements." N. C. Barrett and Benham & Sons, Ltd. March 9th.
6,914. "Device for preventing radio reception on power, light, &c., wiring systems." B. E. A. Vigers. March 10th.
6,915. "Crystal detector for wireless receiving apparatus." T. E. Beaumont. March 10th.
6,921. "Device for audibly indicating whether electric light is out." F. Fairer and A. Shaw. March 10th.
6,930. "Electric apparatus for measuring concentration of electrolytes in water." K. C. D. Hickman. March 10th.
6,931. "Electric switch." J. I. M. Hogg. March 10th.
6,932. "Cooling devices for sparking plugs." W. E. Holdom. March 10th.
6,934. "Wireless apparatus." D. M. Scanlon and M. R. Scanlon. March 10th.
6,951. "Electric condensers." H. Stevens and A. J. Stevens & Co. (1914), Ltd. March 10th.
6,964. "Shade holder for electric, &c., lamps." A. Wilkinson. March 10th.
6,970. "Electric igniter for photographic flashlight powder." J. C. Swan. March 10th.
6,979. "Electric insulators." F. W. Schildt. March 10th.
6,990. "Wireless loud speakers." A. F. Herbert. March 10th.
6,991. "Apparatus for wireless telegraphy and telephony." T. W. Ward-Miller and Sterling Telephone and Electric Co., Ltd. March 10th.
6,992. "Crystal detectors." T. D. Ward-Miller and Sterling Telephone and Electric Co., Ltd. March 10th.
7,017. "Electric power transmission systems." A. M. Taylor. March 12th.
7,018. "Junction boxes for electric power transmission systems." A. M Taylor. March 12th.
7,028. "Aerials for wireless telegraphy, &c." S. T. Headley and J. Tee. March 12th.
7,047. "Method of repairing bonds for permanent way of electric tramways, &c." E. Clark. March 12th.
7,048. "Electric heating apparatus." E. Seregni. March 12th. (Italy, March 11th, 1922.)
7,051. "Receiving broadcast signals." G. W. Hale. March 12th.
7,052. "Telephone or headphone terminal board." J. Joanes. March 12th.
7,055. "Electric light bracket." Sir D. L. Salomons. March 12th.
7,056. "Wireless receiver." E. Bonella. March 12th.
7,057. "Sparking coils for internal-combustion engines." F. W. Lanchester. March 12th.
7,067. "Electric motors." T. Yamamoto. March 12th.
7,071. "Wireless valves." H. C. Phillips. March 12th.
7,072. "Combined filament rheostat and holder for wireless valves." R. J. W. Heath. March 12th.
7,075. "Switches for variable electric resistances, &c." T. L. Jones. March 12th.
7,083. "Contacts for electric knife switches." W. J. Gibbons. March 12th.
7,093. "Aerials for wireless telegraphy, &c." J. C. Round. March 12th.
7,103. "Producing progressive breaking of electric currents." C. Chilowsky. March 12th. (France, March 16th, 1922.)
7,106. "Electric switches." British Thomson-Houston Co., Ltd. (General Electric Co.). March 12th.
7,109. "Plates for electrolytic cells." L. Murphy. March 12th.
7,114. "Electric heating device." L. Gernigon and G. Schauly. March 12th.
7,117. "Crystal detectors." E. A. V. Sanftleben and Telephone Manufacturing Co., Ltd. March 12th.
7,122. "Electric-light fitting." A. E. Bawtree and S. B. Marshall. March 12th.
7,131. "Means for exciting and igniting arcs in metal vapour rectifiers." Akt. Ges. Brown, Boveri et Cie. March 12th. (Germany, March 11th, 1922.)
7,146. "Voltage controlling device for dynamos." G. C. Hubble. March 12th.
7,151. "Electric condensers." P. E. Wells. March 12th.
7,154. "Means for earthing overhead electric conductors." P. G. Mitchell and H. J. Williams. March 12th.
7,159. "Variable condensers for wireless telegraphy, &c." A. E. Watson. March 13th.
7,167. "Electric conductors for alternating current." T. F. Wall. March 13th.
7,190. "Wiring strips." H. F. V. Stagg. March 13th.
7,192. "Devices for charging accumulator cells." A. R. Angus. March 13th.
7,202. "Electric switches." F. W. W. Baker and C. E. Green. March 13th.
7,203. "Automatic, &c., telephone systems." W. Cornell and Coventry Automatic Telephones, Ltd. March 13th.
7,220. "Electric heating element." W. Weekes. March 13th.
7,222. "Means for amplification of audible waves or vibrations in wireless receiving apparatus." E. E. Cadett and J. E. Neall. March 13th.
7,235. "Wireless receiving apparatus." G. Poulton. March 13th.
7,252. "Electric furnace melting of manganese scrap." E. C. R. Marks (American Manganese Steel Co.). March 13th.
7,258. "Electric furnaces." Finspongs Metallverks Aktiebolag. March 13th. (Sweden, March 29th, 1922.)
7,259. "Electric battery cells." Soc. Anon. le Carbone. March 13th. (France, May 4th, 1922.)
7,293. "Crystal detectors for wireless reception." H. H. Groves, March 13th.

7,295/6.—" Dynamo-electric machines." Soc. Anon. Electrolabor. March 13th. (France, March 13th, 1922.)
7,302. " Trolley cars for perambulators, &c." E. D. Field. March 14th.
7,317. " Means for introducing capacity effects in alternating-current systems. &c." T. F. Wall. March 14th.
7,334. " Electrically-illuminated signalling apparatus for vehicles." N. Milnes and F. Weavill. March 14th.
7,341. " Electric apparatus for lighting fires." W. Burke. March 14th.
7,350. " Magnetic blow-out devices for electric circuits, interrupters, &c." Metropolitan-Vickers Electrical Co., Ltd., and N. E. North. March 14th.
7,360. " Electric burglar alarms." B. Harrison. March 14th.
7,372. " Wireless telegraphy, &c." V. S. Roberts. March 14th.
7,381. " Electric iron." Metropolitan-Vickers Electrical Co., Ltd. March 14th. (United States, March 23rd, 1922.)
7,383. " Electric wire connections." R. W. G. Morrison. March 14th.
7,398. " Dynamo-electric machinery." Sir C. A. Parsons and J. Rosen. March 14th.
7,405. " Loud-speaking and sound collecting, &c., apparatus." J. J. Hine and G. Palmer. March 14th.
7,413. " Wireless aerials." E. W. Hynes. March 14th.
7,436. " Sealing-in machines." British Thomson-Houston Co., Ltd. March 14th. (United States, April 24th, 1922.)
7,437. " Electric soldering irons." British Thomson-Houston Co., Ltd. (Compagnie Française Thomson-Houston). March 14th.
7,446. " Sparking plugs." D. Zimmerman. March 15th. (France, March 15th, 1922.)
7,452. " Mountings, &c., for telephone receivers." H. J. Brookes. March 15th.
7,455. " Electric switches." H. J. Dean-Osgood. March 15th.
7,458. " Electric contacts for weighing scales." Automatic Scale Co., Ltd., and E. L. Blick. March 15th.
7,460. " Carrier for electric lamp shades, &c." A. N. Haddow and A. P. Rutherford. March 15th.
7,467. " Device for retaining trolleys on wires, &c." F. Lennan. March 15th.
7,488. " Generation, distribution and control of electric power." J. M. Scott-Maxwell. March 15th.
7,492. " Electric advertising signs, &c." J. Y. Fletcher and J. B. Kramer. March 15th.
7,493. " Transmitting, recording or reproducing sound electrically." J. R. Quain. March 15th.
7,504. " Generation of electric current." Air Liquide Soc. Anon. pour l'Etude et l'Exploitation des Procédés G. Claude. March 15th. (France, May 8th, 1922.)
7,515. " Vacuum electric tubes." E. Y. Robinson. March 15th.
7,525. " Arrangements of electric converting apparatus." H. Barnes, English Electric Co., Ltd., and J. C. Wilson. March 15th.
7,526. " Number dials for automatic telephone systems, &c." F. Baker, E. A. Petithory, and Siemens Bros. & Co., Ltd. March 15th.
7,536. " Electric burglar alarms." A. Bogaert and A. Nocquet. March 15th.
7,544. " Headlights of motor vehicles." M. J. Williams. March 15th.
7,545. " Coin-actuated switch mechanism for electric circuits." R. C. Grasoby. March 15th.
7,547. " Protective apparatus for alternating-current systems." British Thomson-Houston Co., Ltd., and A. S. FitzGerald. March 15th.
7,548. " Electric switches." British Thomson-Houston Co., Ltd. (General Electric Co.). March 15th.
7,552. " X-ray apparatus." F. R. Butt & Co., Ltd., and C. M. Roberts. March 15th.
7,562. " Loud-speaking telephones." C. Leigh. March 16th.
7,565. " Electrostatic condensers." H. J. Dean. March 16th.
7,568. " Electric telephones." G. A. Farmer and H. W. Hemmings. March 16th.
7,578. " Mine signalling device." R. S. Gardner. March 16th.
7,579. " Electric terminals." I. H. Parsons. March 16th.
7,587. " Electric light fittings or lanterns." W. Park, Sunderland Forge and Engineering Co., Ltd., and H. Wight. March 16th.
7,601. " Means for controlling electric circuit of scale mechanism." Automatic Scale Co., Ltd., and E. L. Blick. March 16th.
7,606. " Receiving apparatus for wireless telegraphy, &c." J. B. Bolitho. March 16th.
7,609. " Electric motor-driven apparatus for haulage, &c." A. W. Davies and Mavor & Coulson, Ltd. March 16th.
7,610. " Wireless telegraph, &c., apparatus." W. Kimpton. March 16th.
7,611. " Device for supplying water to tramway rails." E. P. Brook. March 16th.
7,614. " Microphones, phonographs, &c." A. F. Sykes. March 16th.
7,621. " Overhead electric transmission lines." A. A. Bull and Callender's Cable and Construction Co., Ltd. March 16th.
7,622. " Telephone, &c., receivers." H. H. M. Shurlock. March 16th.
7,631. " Multiple-core high-tension cable." Naamlooze Vennootschap Nederlandsche Kabel-fabriek. March 16th. (Holland, March 18th, 1922.)
7,634. " Ignition cut-out, &c., for motor vehicles." E. J. Jenkyn. March 16th.
7,636. " Magneto-electric machines." A. Massey-Allen and R. B. North. March 16th.
7,637. " Inductance coils for wireless receiving apparatus." L. Chaway. March 16th.
7,651. ' Electric accumulators." Chloride Electrical Storage Co., Ltd., and H. Dean. March 16th.
7,662. " Means for starting electric motors." J. Sousedik and R. Suczek. March 16th. (Czecho-Slovakia, March 17th, 1922.)
7,672. " Lightning or surge arresters." Electrical Improvements, Ltd. March 16th.
7,673. " Sparking plugs." H. Mardell. March 16th.
7,682. " Slider and contact bar for wireless tuning coils." H. E. Ming. March 17th.
7,691. " Crystal detectors for wireless telephony, &c." Burton, Delingpole and Co., Ltd., and J. T. Tilley. March 17th.
7,704. " Electric indicator for road traffic." C. Clarke and A. C. Jamieson. March 17th.
7,706. " Head lights of vehicles." W. Checketts. March 17th.
7,725. " Electric cut-outs and applications thereof." H. E. Foard. March 17th.
7,730. " Manufacture of wire-drawing dies, &c." General Electric Co., Ltd. (Patent Treuhand Ges. für Elektrische Glühlampen). March 17th.
7,733. " Means for control of electric machines." R. A. R. Bolton and English Electric Co., Ltd. March 17th.
7,743. " Sparking plugs, &c." P. F. Gueniffey. March 17th. (France, March 18th, 1922.)
7,752. " Generation of waves for wireless telegraphy, &c." H. Morris-Airey, C. Matthews, C. Seymour, and G. Shearing. March 17th.
7,762. " Electric storage batteries." J. F. Monnot. March 17th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1921.

22,717. " Electric motors." British Thomson-Houston Co., Ltd. (General Electric Co.). August 26th, 1921. (193,879.)
23,013. " Signalling systems employing electric oscillations." J. Scott-Taggart and Radio Communication Co., Ltd. August 30th, 1921. (193,882.)
28,243. " Suppression of higher harmonic voltages in alternating-current dynamos." Akt. Ges. Brown, Boveri et Cie. October 28th, 1920. (170,851.)
28,264. " Magneto-electric machines." R. Bosch Akt. Ges. November 8th, 1920. (171,087.)
28,757. " Method of and device for separating suspended particles from electrically insulating fluids, more particularly gases." Lodge Fume Co., Ltd. (E. Möller). October 29th, 1921. (193,903.)
29,322. " Manufacture of thermionic valves." Naamlooze Vennootschap Philips' Gloeilampenfabrieken. November 10th, 1920. (171,379.)
31,755. " Iron-clad electric switches." V. Hope. November 28th, 1921. (193,935.)
31,843. " Windings for the armatures of dynamo-electric machines." W. B. Sayers. November 28th, 1921. (Cognate applications 8,092/22 and 16,302/22.) (193,940.)
32,159. " Working of telegraph cables." E. S. Heurtley. December 1st, 1921. (193,957.)
32,173. " Signalling apparatus for mines and the like." G. M. Harvey. December 1st, 1921. (193,958.)
32,241. " Electro-magnetic devices for the distant control of electric switches." Civi.ingenieure Seyfferth & Hansen Ges. December 6th, 1920. (172,312.)
32,583. " Telephone systems." J. E. Pollak (Siemens & Halske Akt. Ges.). December 5th, 1921. (193,980.)
32,597. " Intermittent alternating current induction train control systems." J. B. Regan. December 5th, 1921. (193,981.)
32,628. " Electric pianoforte driers and the like." P. Watson. December 6th, 1921. (193,984.)
32,716. " Electric lamp fittings." British Thomson-Houston Co., Ltd. (General Electric Co.). December 6th, 1921. (193,988.)
32,904. " Magnetos." H. Lewis. December 8th, 1921. (193,996.)
33,098. " Electric feeder connectors for contact rails on electric railways." P. V. Hunter, J. Mather, and Callender's Cable & Construction Co., Ltd. December 9th, 1921. (194,005.)
33,099. " Supports for electric cables, pipes, and the like." R. A. D. Macallister, J. S. McCallum, and Callender's Cable & Construction Co., Ltd. December 9th, 1921. (194,006.)
33,133. " Method for increasing the frequency of electric currents." H. Sefton-Jones (C. Lorenz Akt. Ges.). December 9th, 1921. (194,007.)
33,171. " Apparatus for electrically precipitating suspended particles from fluids." Siemens-Schuckertwerke Ges. June 28th, 1921. (Addition to 174,046.) (182,425.)
33,490. " High-frequency electric furnaces." Westinghouse Lamp Co. December 13th, 1920. (172,961.)
34,530. " Indicator, sign and annunciator devices and the like." A. A. Mead and Mead, McLean & Co., Ltd. December 22nd, 1921. (194,033.)
34,904. " Controllers for electric motors and the like." Electric Control, Ltd., A. West & Co., Ltd., O. Ellefsen, and H. Brooke. December 29th, 1921. (194,038.)

1922.

814. " Process for the manufacture of telephone receiver cases." S. O. Cowper-Coles. January 10th, 1922. (194,062.)
890. " Sparking plugs." H. E. Fish. January 11th, 1922. (194,063.)
1,149. " Electrical heat generators." L. G. de Kermor. January 13th, 1922. (194,066.)
1,235. " High-frequency telephony systems." E. Pollok. January 14th, 1922. (Cognate application 1,848/22.) (194,070.)
1,270. " Electrical conductors." W. S. Smith. January 14th, 1922. (194,071.)
1,458. " Control of electric motors." E. A. Binney and Metropolitan-Vickers Electrical Co., Ltd. January 17th, 1922. (194,072.)
1,661. " Electrical ship propulsion systems." L. Miller, J. P. Campbell, and Metropolitan-Vickers Electrical Co., Ltd. January 19th, 1922. (194,075.)
2,514. " Packings of the bladed type and methods of manufacturing the same." British Thomson-Houston Co., Ltd. (General Electric Co.). January 27th, 1922. (194,085.)
2,523. " Electric propulsion of ships." C. C. Garrard and A. H. Railing. January 27th, 1922. (194,086.)
2,870. " Methods of making articles of silica." British Thomson-Houston Co., Ltd. (General Electric Co.). January 31st, 1922. (194,092.)
2,897. " Thermo-electric pyrometers." Birmingham Small Arms Co., Ltd., and A. R. Page. February 1st, 1922. (194,094.)
2,989. " Electric power drives." A. B. Field and Metropolitan-Vickers Electrical Co., Ltd. February 1st, 1922. (194,095.)
3,870. " Electric apparatus for the destruction of insects and stinging flies." A. Zaccanti. February 9th, 1922. (194,109.)
4,755. " Visual signalling apparatus for use in connection with colliery and like winding." W. B. Dale, R. A. Hopkinson, and J. Hopkinson & Co., Ltd. February 17th, 1922. (194,116.)
4,766. " Amplifier connections for wireless telegraphy." J. Massolle, Dr. J. Engl, and H. Vogt. February 18th, 1921. (175,657.)
4,944. " Electro-magnets." British Thomson-Houston Co., Ltd. (General Electric Co.). February 20th, 1922. (194,117.)
6,223. " Electric conductors suitable for sealing into vitreous material." British Thomson-Houston Co., Ltd. (General Electric Co.). March 2nd, 1922. (194,133.)
7,126. " Electric switch fuses." Electrical Improvements, Ltd., and R. W. Gregory. March 10th, 1922. (194,142.)
7,346. " Uniting of metal bodies electrically." P. Buckley and Buckley, Saunders & Co., Ltd. March 13th, 1922. (194,144.)
7,510. " Portable electric light fittings." E. C. R. Marks (Colonial Lamp and Fixture Works Inc.). March 14th, 1922. (194,148.)
9,739. " Boxes for carrying electric lamps." H. G. Thompson and A. H. Stevenson. April 5th, 1922. (194,174.)
11,295. " Primary cells." Soc. Anon. le Carbone. March 18th, 1922. (194,185.)
12,393. " Sparking plugs for internal-combustion engines." K. E. L. Guinness. May 2nd, 1922. (194,196.)
12,538. " Electric torches." F. S. Johnson and Ever-Ready Co. (Great Britain), Ltd. May 3rd, 1922. (194,197.)
13,085. " Leading-in conductors for vitreous material." Naamlooze Vennootschap Philips' Gloeilampenfabrieken, G. Holst, E. Oosterhuis, and J. C. Lokker. May 9th, 1922. (194,198.)
13,218. " Loaded signalling conductors." Western Electric Co., Ltd. (Western Electric Co., Inc.). May 10th, 1922. (194,200.)
14,042. " Manufacture of electric incandescent lamps." General Electric Co., Ltd. May 19th, 1921. (180,334.)
17,460. " Dynamo-electric machines." British Thomson-Houston Co., Ltd. (General Electric Co.). June 24th, 1922. (194,221.)
18,359. " Loaded signalling conductors." Western Electric Co., Ltd. August 16th, 1921. (184,783.)
21,691. " Wireless telegraphy." H. Abraham. August 9th, 1921. (Addition to 169,997.) (184,475.)
25,494. " Electric switches." Metropolitan-Vickers Electrical Co., Ltd. February 14th, 1921. (Divided application on 175,629.) (186,341.)
27,089. " Electric head lamps for motor-cars and other like lamps." W. E. Marshall and P. G. P. McCulloch. April 27th, 1922. (Divided application on 190,408.) (193,795.)
31,769. " Cabinet talking machines." Telegraphie Ges. System Stille. December 17th, 1921. (190,400.)
33,192. " Speed-controlling devices for railway and tramway trains." E. Rodolausse. December 5th, 1921. (Addition to 182,617.) (189,811.)
33,587. " Process for the manufacture of fused quartz by the electric furnace." Soc. Anon. Quartz et Silice. December 16th, 1921. (190,476.)
33,588. " Process for the manufacture of fused quartz by the electric furnace." Soc. Anon. Quartz et Silice. December 16th, 1921. (190,477.)